

**AN EVALUATION OF FOODS PROCESSED
IN TRAY PACK VERSUS TWO STANDARD
FOOD SERVICE CONTAINERS
Part 1: Sensory, Container and Bacteriological
Tests**

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19. ABSTRACT (Continue on reverse if necessary and identify by block number) Purpose of the study was to evaluate nine main meal foods over a 36-month period of storage. Three processing/packaging combinations of each food were included: (1) precooked frozen, packed in half-size steamtable aluminum foil trays; (2) heat-processed in cylindrical No. 10 cans; and (3) heat-processed in rectangular tray cans. Frozen products were stored at a constant -18°C (-0°F); heat-processed products at 21 and 38°C (70 and 100°F). Products were evaluated initially and following 6, 12, 18, 24 and 36 months storage. Two sensory panels were used concurrently for product evaluations: (1) a panel of food technologists using a quality evaluation scale, and (2) a Natick RD&E Center employee panel using an hedonic scale. In addition to the sensory evaluations, interior surfaces of the containers were examined for corrosion after selected periods of storage. Prior to initial and six-month evaluations, all products were bacteriologically cleared for consumption. Sensory tests generally indicated that expected storage life of Tray Packs exceeded that of cylindrical cans at both storage temperatures. Precooked frozen products were				
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one single product

cont. → generally highest rated, and No. 10 heat-processed products were lowest. Thus, of the heat-processed products, the Tray Pack foods were rated "preferred". The expected storage life in months is given for each precooked frozen entree at -18°C and for each No. 10 can and Tray Pack at both 21°C and 38°C.

→ The interior enamel food contact coating of the tin-free steel container used for the Natick RD&E Center-produced foods was the most resistant to attack over the 36-month period of the study. Least resistant was the aluminum foil pan which, for two precooked and frozen foods, was corroded/pitted after 18 months.

→ In the bacteriological test, both procured and Natick RD&E Center-produced foods were completely sterile when examined prior to the initial and six-month sensory tests. Precooked frozen foods had aerobic plate counts that were well below Military standards and contained no fecal coliforms.

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PREFACE

This study was initiated by the Food Engineering Directorate (FED), U.S. Army Natick Research, Development and Engineering Center (NRDEC),* and financed under Project 1L762724AH99 - Joint Services Food/Nutrition Technology, Technical Effort AH99BC - Food Packaging during 1976 to 1979.

Of the nine entree food products evaluated, four were developed by the late Raymond G. Young, Food Technologist in FED's Product Development and Engineering Branch. The products that were filled and closed in number 10 cans and Tray Packs were under the supervision of Joseph Szczeblowski, formerly Physical Scientist (Packaging) in FED's Subsistence Protection Branch, who developed the test and evaluation plan with other collaborators and was responsible for storage and withdrawal of products at scheduled intervals. Product sensory evaluations that involved FED food technologists and use of the food quality scale were conducted by FED's Ration Design and Evaluation Branch, Mary V. Klicka, Chief; Margaret Branagan, same Branch, constructed the Appendix Tables. Robert A. Kluter designed and supervised the consumer evaluations conducted by the Sensory Analysis Branch, Science and Advanced Technology Directorate (SATD).

The authors are indebted to Dr. Gerald Powell, formerly Staff Statistician for the Behavioral Sciences Division, SATD, for reanalyzing the acceptability data and for his helpful interpretations of the statistical procedures.

This report is Part 1 of a two-part series. Part 2 is subtitled Nutritional Analyses by Leslie A. Wyzga, Mary V. Klicka, Christine A. Kubik, Joseph W. Szczeblowski (NATICK/TR-86/012).

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AN EVALUATION OF FOODS PROCESSED IN TRAY PACK VERSUS TWO STANDARD FOOD SERVICE CONTAINERS

PART 1. Sensory, Container and Bacteriological Tests

INTRODUCTION

For the U.S. high-volume segment of the food service industry, the 1970s were marked by an emphasis on convenience foods, brought about in great part by rapidly rising labor and energy costs. Simultaneously, the military services were considering new or redesigned garrison and field feeding systems to reduce the numbers of trained cooks needed to facilitate rapid deployment of food service units in the field.¹

U.S. Army Natick Research, Development and Engineering Center (NRDEC) food and packaging scientists first became interested in the concept of hermetically sealed multi-serving containers when they learned that in 1969 a Swiss group had developed a line of heat-sealable, sterilizable, single-serve containers.²

In the early 1970s, major U.S. packaging materials and container manufacturers were contacted regarding their interest in developing a rectangular half-size steamtable container that would fit into standard steamtable openings. Of various containers evaluated for resistance to heat-processing and to contact with corrosive foods, one emerged as worthy of further evaluation. It was a two-piece unit consisting of a body air-drawn from an aluminum polypropylene laminate and a heat-sealable membrane cover. Preliminary consumer evaluations of three entree items over a six-month storage period indicated that two of them were as acceptable, or more so, than their precooked frozen equivalents. The other, a macaroni and cheese item, was more acceptable in frozen form. Container performance proved satisfactory for all three items over the term of the study.³

By the mid-1970s, Kraft, Inc., and Central States Can Co., independent of each other, developed rectangular tinplate and tin-free steel containers, respectively, with double-seamed lids. These containers had the same capacity as a number 10 can, but required approximately one-half the heat processing time in a still retort to achieve commercial sterility. For serving, they were reheatable in a water bath, could be opened with a standard can opener, and would fit in a standard steamtable, two trays per opening.^{4 5} In late 1975, Kraft began test-marketing five entrees in their version of the container.^{6,7,8} High acceptability of these items was claimed in three different food service settings - a private hospital, a university and a public school system.

Concurrently, the four U.S. military services were developing field food service system concepts that included convenience foods packed in the tray container, referred to hereafter as the Tray Pack. The first field consumer acceptance data on these foods was obtained during four Air Force exercises. Acceptability of the majority of the items - entrees, starches, vegetables,

and desserts - was considered high as were overall meal ratings for the two menus served. In another garrison evaluation, six Tray Pack entrees were rated against their precooked frozen and kitchen prepared counterparts. Tray Pack item acceptability was equivalent to or better than kitchen prepared. In a third study, ratings of NRDEC employee consumer panels were combined with those from trials with two other military services. Of 22 Tray Pack entree items evaluated, ratings for 20 of these were considered in the acceptable range (6.0 or higher on the nine-category hedonic scale), confirming the other studies.⁵

To this point, no studies had been conducted with the steel container to determine: (1) comparative sensory quality and acceptability with no. 10 cans and precooked frozen packed foods; (2) shelf life of Tray Pack vs. the no. 10 can at ambient and stressful storage temperatures; (3) changes in nutrient composition, in particular, vitamin levels from raw to processed phases and when reheating and holding processed foods; (4) bacterial counts, both postprocessing and after six months of storage; and (5) container integrity over time. This study was an effort to address the above information needs/objectives and provide a data base to facilitate successful launching of Tray Pack foods in various military field food service systems.

EXPERIMENTAL APPROACH

Design of Experiment

Two concurrent sensory studies were designed to assess, separately, changes over a 36-month period in quality and acceptability occurring in nine meat, poultry, or pasta combination foods. The independent variables considered in this study were as follows.

1. Storage time. Sensory evaluations were conducted shortly after packing (initially) and after 6, 12, 18, 24, and 36 months.

2. Containers and Processes

- a. Frozen, precooked (FP). NRDEC products were packaged in half steamtable size Ecko disposable formed aluminum foil pans with a full curl rim. Covers were rigid foil crimped on by an Ecko closing machine described in Appendix B. The Kraft-produced items were packed in Reynolds tray of the same construction with plug-type foil coated paperboard lids crimped on.

- b. No. 10 cylindrical can (CC), hermetically sealed. Products were heat processed to commercial sterility.

- c. Tray Pack (TP). The container, as previously described, had contents processed to commercial sterility.

3. Storage Temperatures. The frozen precooked products were stored at a constant 18°C; by design, no further evaluations were conducted after the 18-month withdrawal. Thermally processed products were divided into sublots,

which were stored at 21°C and 38°C. After the 18 month evaluation, again by design, tests on 38°C stored products were terminated. Evaluations of 21°C stored products were continued after 24 months and concluded after 36 months of storage.

Figure 1 is a schematic for the sensory evaluations and other analyses performed during this study. Figures 2 and 3 are photographs of the three container types investigated.

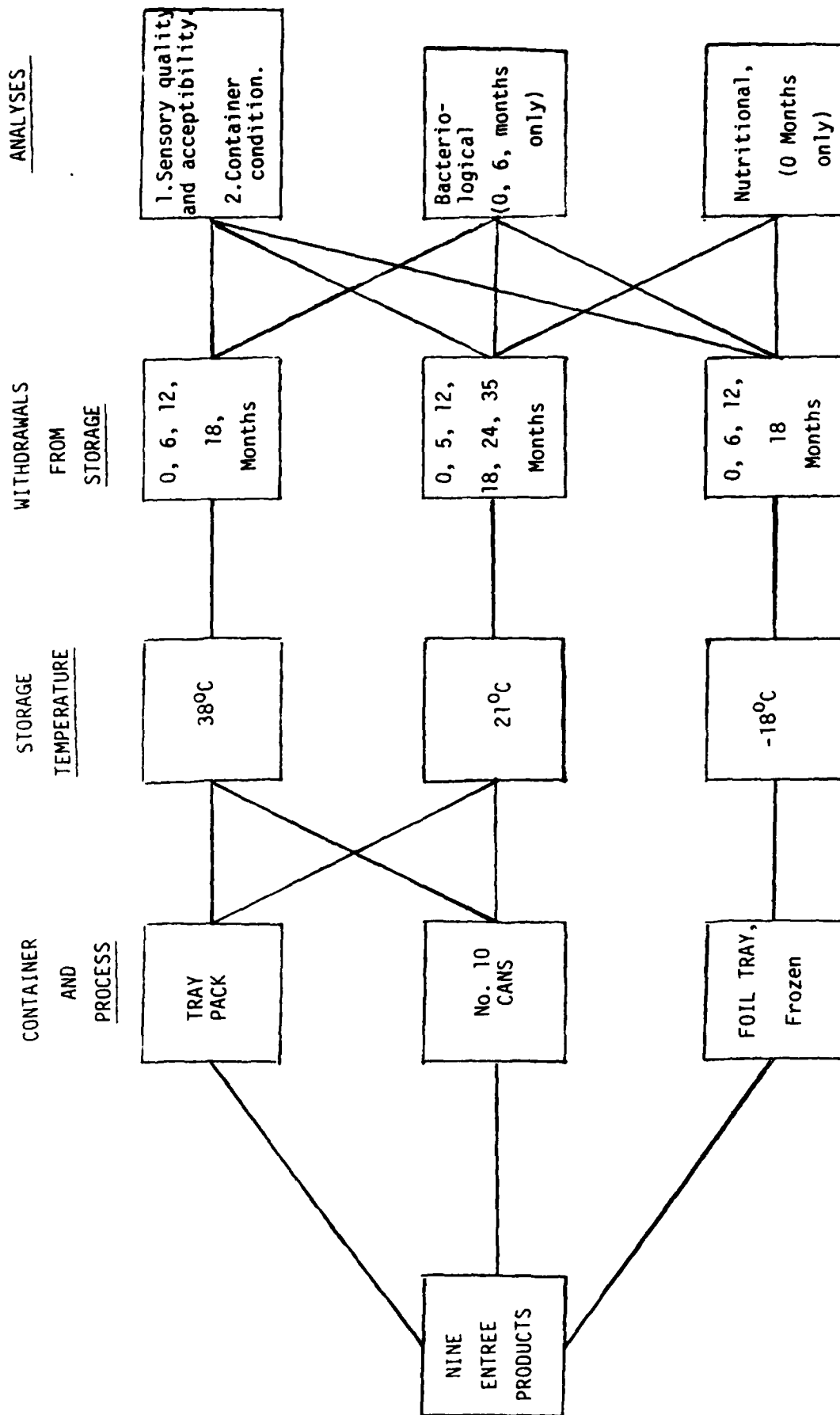
Sources, Preparation and Presentation of Foods for Sensory Panel Evaluations

Five of the nine entrees were commercial items produced by Kraft, Inc. in all three container types. These were: Beef, Ravioli, Beef Stew (Figure 2), Chili with Beans, Creamed Chicken (Chicken a la King), and Macaroni and Cheese. Formulas were not made available to NRDEC, but label declarations in order of predominance are given in Appendix A, Parts 1 through 5. The standard cylindrical can for the creamed chicken pack was a no. 3 tall size; all others were no. 10. The other four products were formulated and produced by technologists in the Food Engineering Laboratory's Pilot Plant. These were: Beef Burgundy with Rotini (Figure 3), Chicken Cacciatore, Smoky Pork (a barbecue-type item), and Swiss Steak. Formulas and processing procedures for these items are given in Appendix B. Note that for each of these four products, frozen and heat processed packs were prepared in the same manner, except for the starches used in sauces or gravies. Products for both acceptance testing and sensory quality scoring were reheated simultaneously in a forced-convection oven. Table 1 indicates the experimentally derived reheat times at 177°C to reach the desired serving temperature.

TABLE 1. Reheating Schedule, Nine Entree Items, General Electric Model CN90A Forced - Convection Oven Preheated to 177°C*

Item	Frozen	Precooked	Process/Package	Tray Pack
			Cylindrical Can (Minutes)	
Beef Burgundy with Rotini	105		55	35
Beef Ravioli	80		55	35
Beef Stew	90		55	35
Chicken Cacciatore	100		50	35
Chili con Carne	60		45	30
Creamed Chicken	70		55	30
Macaroni & Cheese	70		55	25
Smoky Pork	100		50	35
Swiss Steak	105		55	35

*Time Required to reach 74°C serving temperature.



Footnote:
(1.) For Kraftco items, no nutritional analyses were conducted.
Results for NRDEC Products are covered in a separate technical report⁹.

Figure 1. Container and process, storage conditions, and other analyses performed for nine entrees.

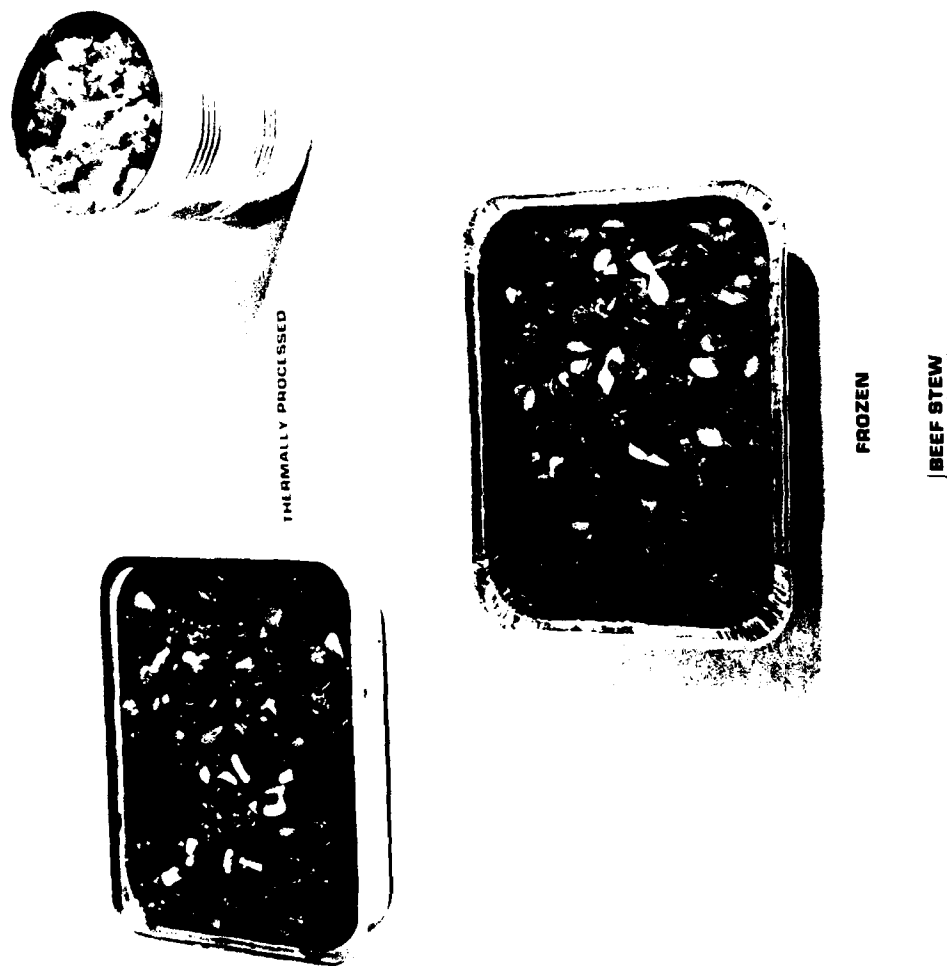
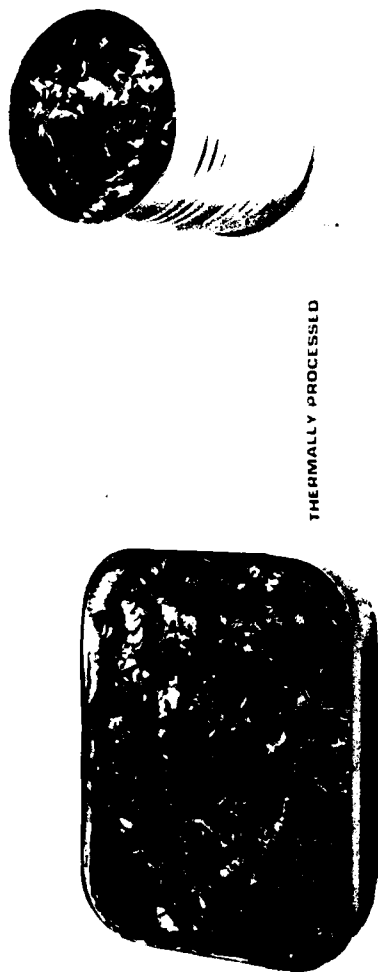


Figure 2. Beef stew packed in the three container types investigated.



THERMALLY PROCESSED



FROZEN

BEEF BURGUNDY
W/VEGETABLES AND ROTINI

Figure 3. Beef burgundy with vegetables and Rotini packed in the three container types investigated.

Procedures were as follows:

1. Frozen precooked foods. Containers were kept in frozen condition until reheated. They were placed in the preheated oven after lids were perforated in several places to prevent steam. After 10 minutes, trays were removed from the oven and contents transferred to half-size stainless steel pans to ease later handling and serving. These pans were covered with perforated heavy duty aluminum foil and placed back into the oven until reheating was completed.
2. No. 10 cans. Contents of these cans were transferred directly to half-size stainless steel pans, covered with foil as above, and placed in the oven.
3. Tray Packs. Lids were punctured in several places to vent steam, and trays were placed intact into the oven. Lids were removed after heating with a counter-mounted stab-type can opener.

Since like products in the three container types required different reheat times to reach the desired serving temperature (74°C), products were placed in the oven in the order of the longest to shortest reheat times given in Table 1. After reheating, products were held in a steamtable or water bath to maintain the 74°C serving temperature. Preheated ceramic sauce dishes or flat plates, as appropriate for the food type, were used for acceptance evaluations as an additional temperature control measure.

A single sensory panel session for each of the nine entree items was required for both quality scoring and acceptance evaluations at each withdrawal from storage. Through the first 18 months, each panel session, including the initial evaluations, comprised five samples: The precooked frozen product and the no. 10 can and Tray Pack products allocated to the 21°C and 38°C storage conditions. At the 24 and 36 month withdrawals, only the no. 10 cans and Tray Pack products stored at 21°C were evaluated by the quality and acceptance sensory panels. For quality scoring evaluations, samples were presented simultaneously in prewarmed coded sauce dishes covered with aluminum foil. They were evaluated one at a time in a prescribed position-balanced random order. For acceptability testing, samples were presented one at a time for evaluation by panelists. Dishware and any leftover samples were returned prior to presenting another sample; presentation order was identical to the quality scoring procedure.

Selection of Panelists

Quality Scoring. Food technologists involved in product development activities were asked to describe specific attributes of appearance, odor, flavor, and texture they observed in both precooked frozen and thermostabilized forms of each of the nine entree items. These observations were compiled and summarized for each food for use as descriptive standards in subsequent evaluations. These word standards were then included as part of the standard test instructions with the ingredient declaration for each food. (See Appendix C for descriptions and Appendix D for rating form). All

personnel participating in these evaluations had previously evidenced their ability to discriminate among foods of the same kind on the basis of general characteristics of color, odor, flavor, and texture. Twenty panelists participated per session initially; however, as the study progressed to 24- and 36-month withdrawals, as few as 11 of the original individuals remained available. Each general attribute was rated according to the nine-category quality scale at the top of the form.

Acceptability Evaluations. For each session, panelists were telephoned from the randomly arranged list of nearly 450 NRDEC volunteer panelists. Food technologists on this list were specifically excluded from this series of evaluations inasmuch as they were being utilized in quality scoring panels. The remaining individuals on the list were experienced in making consumer-type judgments on a wide variety of foods, but they had no specific training in food judging. They were not aware of the food to be rated until their arrival at the Food Acceptance Laboratory, nor were they aware of the nature of the study. The nine-category hedonic scale test form used is reproduced in Appendix D.

All sensory quality scoring work was conducted by the Ration Design and Evaluation Branch, Food Engineering Laboratory, and all acceptance evaluations were conducted by the Sensory Analysis Branch, Science and Advanced Technology Directorate.

Statistical Analyses of Sensory Data

Numerical scores from both quality attribute and acceptability ratings were subjected to an analysis of variance (ANOVA). Follow-up Newman-Keuls vs. Duncan multiple range tests were computed when F-ratios were significant to determine to significant differences between mean scores. Because one objective of the study was to determine if significant differences over storage time would occur between like foods heat processed in cylindrical cans vs. Tray Packs, other ANOVAs were computed for both quality and acceptability panel scores. These computations must be considered "statistically convenient" since they departed from the design of the study by selectively excluding variables as indicated below.

1. Over the first 18 months, a three factor analysis to determine the effects of storage time, storage temperature, and process/container. Here frozen sample data were excluded.

2. Because storage time of the 21°C no. 10 and Tray Pack processed foods was, by plan, extended to 36 months, data from all withdrawals were compared separately in a two-factor ANOVA, again as if they had been the only variables studied (the 38°C stored and the precooked frozen products were excluded). Here the factors were storage time and process/container only.

An additional two-factor ANOVA was computed for acceptability panel scores that included the frozen samples. In this case process/container and storage temperature were combined as individual treatments or lots, according to the original experimental design. This analysis covered the initial 6, 12

and 18 month withdrawals, the period during which all treatments were evaluated. The follow-up Newman-Keuls routine included multiple comparisons for significant differences between one mean score and every other mean score in addition to its normal use to determine significance of differences between main variables. For purposes of data interpretation, however, only row and column comparisons were relevant, as these represented the independent treatments studied.

Food Containers

Description. Container and coating descriptions for US Army Natick RD&E Center produced products were as follows.

1. Foil tray/lid (precooked frozen products). Ecko Products, Inc. plain aluminum foil tray, plug paperboard lid laminated with aluminum foil on the interior surface.

2. Number 10 (603 x 700) can (heat processed products). American Can Co. Designation 4J oleoresinous (C enamel) coating, body and lid, on interior food contact surface; plain tin exterior.

3. Tray Pack (heat processed products). Central States Can Co. Dimensions: 313 mm long, 254 mm wide, 51 mm deep (12-5/16" x 10-1/16 x 2"). Tin-free steel. Interior food contact coating designation S-9009-102 (modified vinyl). Exterior coating S-9364-001 (epoxy).

Interior surfaces of containers used by Kraft for heat processed Tray Packs and cylindrical cans were enameled in accordance with the best commercial practice by the can manufacturer. Coating designations were not provided. Construction of trays and lids for precooked frozen products was the same as for Natick RD&E Center produced products.

Examinations. The Natick RD&E Center Subsistence Protection Laboratory conducted visual examinations of interior food contact surfaces of each container type following selected periods of storage under each temperature condition. For each examination, the Sensory Analysis Branch, SATD, provided two washed and dried containers with lids from each of the five storage conditions following evaluation of the products. Tray and cylindrical can interiors were examined for (1) coating, staining, softening and blistering; (2) coating failure (separation and removal), and (3) detinning and/or corrosion as appropriate for construction of the container. Aluminum foil pans for the frozen products were examined for signs of corrosion and subsequent pitting failure. Standard guides for container condition were used as they applied to a particular container type.

Bacteriological Tests

Prior to the initial sensory evaluations and the evaluations following six months storage, the Natick RD&E Center Microbiology Branch, SATD, conducted standard bacteriological tests to certify safety for human consumption. Both Natick RD&E Center and Kraft products were subjected to

these tests. Aerobic plate counts (APC) and most probable number (MPN) coliform counts were run on all precooked frozen foods. In the event coliforms were detected, a fecal coliform test was run. Mesophile and thermophile determinations for both aerobic and anaerobic organisms were run on all foods heat processed in Tray Packs and the standard cylindrical cans. Before these containers were opened for the initial determinations, they were incubated at $35^{\circ} + 2^{\circ}\text{C}$ for 10 to 12 days to promote outgrowth of any thermophilic organisms present. The six month samples were not subjected to incubation since half the stored foods had undergone 38°C storage during this period. Two containers of each food product were sampled; in the case of Natick RD&E Center produced foods, which were made in two separate lots, sampling was one container per lot.

Nutritional Analyses

This portion of the study is covered in a separate Technical Report.⁹ It includes both proximate and vitamin analyses of selected foods evaluated in this study.

RESULTS AND DISCUSSION

General

Sensory data are presented as tables in the following four Appendices.

1. Appendix E Tables 1 to 9. Mean Quality Scale (QS) ratings by food technologist judges are presented without further statistical analysis for the five container-storage condition combinations over time. Comments are therefore restricted to observations of rating trends over time and relative differences among the five samples of each food product. It should be noted that the number of panelists ranged from a high of 20 initially to a low of 9 at 24 months. This was brought about by departure of panelists originally selected for the study or their inability to participate in the later sessions.

2. Appendix F. Acceptability (Hedonic Scale - HS) ratings only are given in this table for the five container-storage temperature combinations over time. Although the 24 and 36 month ratings were not included in the two-factor ANOVA as indicated before, they are given here for comparison with the earlier ratings, and because the mean values over time given in Appendix G are averaged across no. 10 and Tray Packs. The unconfounded significant differences for each food, i.e., those occurring among container-temperature combinations (rows), or among storage times (columns), are mentioned in the text since notation in the table might cause confusion.

3. Appendix G. Presented are results of a two-factor ANOVA for both QS and HS data in which, for statistical convenience, 21°C stored no. 10 can and Tray Pack QS and HS ratings were analyzed over 36 months of storage. This analysis was necessitated by the experimental plan to terminate storage and evaluation of the precooked frozen and 38°C stored heat processed packs at 18 months, beyond which they were not expected to be serviceable.

4. Appendix H. Given in this table are results of a three-factor ANOVA of QS and HS data in which, for statistical convenience, data for the precooked frozen product was excluded. This analysis was computed to isolate the main effects of storage temperature and container (process time) for each of the nine heat processed foods.

Open-Ended Comments

Reference to additional written comments by food technologist judges about the five QS attributes is made in the text following when the comments help explain significant differences in mean ratings. The same policy pertains to open-ended comments from consumer panel (HS) data. Unfortunately, not all such remarks were tabulated due to personnel shortages during the study.

Sensory Panel Results

Beef Burgundy with Rotini (NRDEC). Quality scale (QS) means are given in Appendix E, Table 1. For all five attributes rated, mean scores for the precooked frozen (PF) product were equivalent to scores for the Tray Pack (TP) product for withdrawals over the first 18 months of the study. Scores for the no. 10 cylindrical canned (CC) product were equivalent to TP scores initially, but tended to decrease at a greater rate over the same period than TP scores. QS data also indicated that the 38°C stored TP product held up somewhat better after 18 months than the CC product.

Hedonic scale (HS) data, presented in Appendix F, indicated only one significant difference: At the 18 month withdrawal, the 21°C stored TP was rated significantly higher than the 38°C CC sample.

When storage of the heat processed TP and CC samples was extended to 24 and 36-months at 21°C (Appendix G), there were no significant changes in ratings averaged across the two container types except for the QS texture attribute. This significant effect seemed attributable more to inconsistency in technologists' ratings between 18 and 36 months than to any physical changes occurring in the product (see also Appendix E, Table 1).

In the three-factor analysis of variance output (Appendix H), significant differences occurred for the three main effects of storage time, container, and storage temperature due to the 38°C samples. Over time, a significant decrease in QS ratings occurred for all attributes except appearance; HS data indicated no significant change. The TP sample was rated significantly higher than the CC sample for odor, flavor, and overall quality ratings. There were, however, no significant differences in acceptability. Finally, the 21°C were rated significantly higher than the 38°C samples on the QS attributes of odor and flavor and also on HS acceptability; the magnitudes of these differences were, however, small.

Beef Ravioli (Kraft). In general, QS data in Appendix E, Table 2 indicated that technologists perceived the TP product to be somewhat higher in quality than the CC or PF products over 18 months at both storage

temperatures. This was also generally the case with acceptability ratings given in Appendix F, although the 38°C TP product decreased significantly at 18 months from the initial and six month ratings. Food technologists' QS ratings over the same period (Appendix E, Table 2) suggested, however, that the TP product was stable. When storage time of the 21°C product was extended to 36 months (Appendix G), no significant changes in QS ratings occurred when averaged across both TC and CC containers; however, consumer panelists rated the later withdrawals significantly higher than the earlier ones.

With respect to the container main effect, the TP rated significantly higher than the CC only on the QS texture attribute, and consumer panel ratings produced a significant difference in the opposite direction. The three-way analysis of variance given in Appendix H corroborated the Appendix G analyses on storage time means across both container and temperature. There were no significant changes in any QS attribute over 18 months. With acceptability, there was a significant decrease between the six month and the 12 month sampling which was not repeated at 18 months. The TP rated significantly higher than CC on flavor, texture and overall quality; this was confirmed by acceptability ratings in direction only. For storage temperature, the 21°C was significantly higher than the 38°C on the QS flavor attribute; but magnitude of the difference was small. Except for noted discrepancies between QS and HS data, other statistical analyses of the sensory data suggested the TP and CC products were stable over time at both storage temperatures.

Beef Stew (Kraft). QS scores, given in Appendix E, Table 3, indicate that, in general, the PF product rated higher over the first 18 months of the evaluation. Over the same period, the TP product was scored somewhat higher than the CC, and scores of the 38°C stored products decreased at about the same rate for all attributes. Acceptability data in Appendix F corroborated these findings. The single significant time effect was with the 38°C TP samples - the initial rated significantly higher than 18 month sample; after six months the PF product rated significantly higher than CC product stored at both 21°C and 38°C; at 18 months, the PF product rated significantly higher than all heat processed products, and the 21°C stored TC, in turn, was significantly higher than both 38°C stored samples.

An effect of extending storage time of the 21°C TP and CC samples (Appendix G) was seen with all QS attributes except appearance; a significant decrease from initial perceived quality levels was seen at the 24 month withdrawal or afterwards in flavor, texture and overall quality. At 18 months, technologists noted sour odors. Bitter, metallic scorched and slightly sour off-odors were noted in the 38°C stored CC product. Acceptability ratings, however, suggested products were stable over the same period. The TP product was rated significantly higher in flavor and overall quality across storage times on the QS scales; magnitude of these differences was small and was not supported by similar differences in acceptability ratings.

In the three-factor ANOVA, Appendix H, in which the 38° stored samples were included, significant decreases in all QS attributes except

appearance occurred by 12 months or afterwards. Significant differences were found in all but the appearance and texture attributes between storage temperatures and containers; 21°C rated higher than 38°C and TP higher than CC. A significant difference between TP and CC was also found in acceptability ratings, but ratings between storage temperatures across the other two variables were identical.

Chicken Cacciatore (NRDEC). As shown in Appendix E, Table 4, the PF product QS attribute ratings were equivalent to TP ratings over the first 18 months. For all attributes, the TP products tended to decrease in perceived quality at a lesser rate than the CC products. With respect to acceptability ratings (Appendix F), the PF product was rated significantly higher than both the 38°C stored heat processed products beginning with the six month withdrawal and at 12 and 18 months. At 12 months the 21°C TP rated significantly higher than the 38°C CC, and at 18 months both the 21°C TP and CC products rated significantly higher than the 38°C CC product. Over storage time, both initially evaluated heat processed products were rated significantly higher than the 18 month products stored at 38°C.

When the 21°C stored TP and CC products were statistically analyzed for changes over time (Appendix G), significant decreases in QS flavor and overall quality scores were noted at 18 months, and significant decreases in all attribute scores occurred by 24 months. Technologist judges observed darkening of the tomato base sauce at 24 months, scorched and metallic odors and flavors by 18 months, and dry, fibrous/stringy meat at 24 months. Bitter, sour, and oxidized flavors were also noted at these later withdrawals. In addition, the TP was rated significantly higher than the CC product for all attributes but texture. As can be seen in the same table, however, acceptability ratings did not follow a similar trend with respect to storage time or container.

When the 38°C stored heat processed products were included in the three-factor ANOVA, significant decreases in all QS attribute and HS ratings were observed between initial evaluations and the six month withdrawal. In Appendix G, notable decreases between the two evaluations had already been seen in QS ratings, but they were not statistically significant. In Appendix H, as in Appendix G, the TP product was rated higher in all QS attributes as well as for acceptability (Appendix H only). Finally, Appendix H indicated that the 21°C stored heat processed products rated significantly higher in QS flavor and overall quality than the 38°C stored products and in HS acceptability. It was clear from the statistical analyses that food technologists and consumer panelists reacted similarly to the 38°C stored products. By 12 months, consumer comments suggested negative reaction to chicken meat texture: nearly one-third of the panel commented on "stringy" or "dry" meat in both the TP and CC products. A similar proportion of the consumer panel made texture comments at the final (36 month) withdrawal of the 21°C TP and CC products.

Chili con Carne (Kraft). As indicated in Appendix E, Table 5, both the CC and PF products were scored somewhat lower in QS flavor and overall quality over 18 months than the TP product. Flavor and overall quality scores of the

38° TP products decrease considerably by 12 months while 38° CC product scores, which were somewhat low initially, changed little over the same period. The PF product exhibited the same level and pattern of scores as the 38° CC product for these two attributes. Technologist judges characterized the 38°, 18 month TP product as tasting "sour", "stale", and "tinny".

Over the first 18 months of the study, acceptability ratings (Appendix F), in general, were characterized by (1) high standard deviations, particularly through the 12 month withdrawals and (2) particularly in the case of both 21° stored heat processed products, by mean ratings that were counter to trends ordinarily observed over time, i.e., they increased rather than decreased. There was no apparent reason for this occurrence. The post hoc Newman-Keuls analysis indicated that both the 12 and 18 month 21° stored CC products received a significantly higher score than the initial sample. Other significant differences appeared at the 12 month withdrawal only: The PF product was rated significantly higher than the 21° TP and CC products stored at both temperatures; the 21° TP rated significantly higher than the 38° CC.

Storage time extension of the 21° TP and CC products, shown in Appendix G, did not result in significant changes in any quality attributes rated by technologists. However, the increasing rather than decreasing consumer ratings over time were also evident when they were averaged across both container types. Averaged across storage time, the TP was rated significantly higher than the CC product for the QS attributes of odor, flavor, and overall quality as well as for HS acceptability. In the three-way analysis of variance, Appendix H, which included both storage temperatures, a significant decrease in QS odor, flavor, and texture scores was noted between 12 and 18 months. Acceptability scores gave evidence of the reverse trend as noted before. Significant differences between containers did not occur except for the QS flavor scores. Finally, the 21° stored product was rated significantly higher than the 38° product on QS flavor and overall quality attributes and HS acceptability.

Creamed Chicken (Kraft). QS data are given in Appendix E, Table 6. Overall, the PF product exhibited stability in all attributes over 18 months and dropped slightly in texture and overall quality over that period. Over the same period, the 21° stored TP product was rated higher than the 21° CC product on all attributes; for the odor, flavor, and overall quality ratings, this difference approached one scalepoint for all withdrawals. All attribute ratings for the 38° stored CC product decreased at a greater rate than those for the 38° TP product, as evidenced by the sharp drop for the former between the initial and six month evaluations.

Acceptability ratings are exhibited in Appendix F. Frozen sample ratings, as with Chili con Carne product ratings discussed previously, also were a reversal of the normal trend over time; no additional information (descriptive observations, written comments) was available to explain product changes, if any, that might have occurred. Ratings for the 21° stored heat processed products also exhibited the "reverse order" phenomenon over 36 months. The main significant finding was a clear separation of sample ratings at 18 months. Both the PF and 21° TP products were rated significantly

higher than the 38°C TP and CC products. At 12 months, the PF product rating was significantly higher than the 38°C CC. Finally, the 12 and 18 month PF product ratings were significantly higher than initial product ratings, the reverse trend mentioned above.

In the two-way analysis of variance of 21°C stored TP and CC products over the 36 month period (Appendix G), QS texture was the only attribute to decrease significantly from initial ratings. This occurred at 24 months. Technologists' comments indicated the meat component in both container types was tough, dry, chewy and stringy. For each attribute, the TP was significantly higher rated than the CC product. Averaged across both container types, HS acceptability ratings corroborated QS ratings except for the initial sample rating. However, there was no significant difference between container types which suggested either that consumer panelists did not react differently to quality differences or that quality differences were unnoticed.

In the 18 month three-way analysis of variance of the heat processed products, Appendix H, the observed decrease in QS odor, flavor, and overall quality attribute scores between initial and six month withdrawals was significant. The TP product was rated significantly higher than the CC product on all attributes, and 21°C stored product rated significantly higher than the 38°C products, also on all attributes. HS acceptability data in this statistical analysis did not corroborate QS data with respect to storage time. This was explained by a significant time-container interaction term in the ANOVA, a reflection of the variability and "reverse order effect" over time observed with the 21°C product ratings. However, the main container effect indicated a significantly higher overall rating for the TP over the CC product.

Macaroni and Cheese (Kraft). Mean QS ratings are given in Appendix E, Table 7. Odor, flavor, and overall quality scores over the 18 month period placed the TP product in the poor to fair quality range from the outset. The product was informally regarded as a poor execution likely attributable to ingredient and/or processing problems. QS ratings for the same attributes of CC product were as much as one scale-point higher initially and through 12 months than the TP product, but tended to converge on the TP ratings at 18 and 24 months. Ratings for 38°C stored product in both container types indicated a substantial loss in appearance, odor, flavor, and overall quality between the 12 and 18 month withdrawals. The 21°C stored products were evaluated at 24 months after which evaluations were terminated.

All planned acceptability tests were conducted as indicated in Appendix F. In general, ratings for heat processed products were close to the neutral HS category with relatively high standard deviations. The CC product was rated higher than the TP product at both storage temperatures at each withdrawal over the 18 month period for which the analysis of variance was computed. Initially and at 12 months, the PF product was rated significantly higher than TP products at both storage temperatures, and 6 and 18 months, significantly higher than the 38°C stored product only.

In Appendix G, statistical analysis of QS scores for extended storage of 21°C CC and TP products indicated no significant changes between initial and 24 month (final) withdrawals, or for HS ratings, between initial and 36 month ratings. Again, however, it should be noted that initial ratings were low in both instances. Analyzed by container across storage time, the CC was rated significantly better than the TP product in odor, flavor and overall quality attributes as well as in acceptability.

The 18 month three-way analysis of variance of the heat processed products given in Appendix H confirmed the QS and HS results for the effect of container. With the storage temperature effect included, however, there was a significant decrease in QS odor, flavor, and overall quality scores between initial and 18 month withdrawals. No significant differences were found over this period with HS ratings. For all QS attributes except texture, scores were significantly higher for 21°C over 38°C stored products; HS ratings indicated the same direction and statistical significance.

Smoky Pork (NRDEC). QS ratings are given in Appendix E, Table 8. Except for the appearance attribute, initial ratings for the PF product were equivalent to heat processed product ratings. Over time, scores for the CC products decreased at a faster rate than those for TP products. Over the first 18 months, scores for 38°C stored heat processed products decreased at a faster rate than those for the 21°C stored products. Within the 21° storage series of TP product, there was a sharp decrease in scores for all attributes between 18 and 24 month withdrawals. The rate of decrease in odor, flavor, and overall quality scores was greatest for the 38°C stored CC product.

Acceptability ratings for 21°C stored products, Appendix F, varied randomly over 36 months. Consumer ratings for the 38°C stored CC product showed the same rapid decreases as technologist panel scores. At six months, the PF product rated significantly higher than the 38°C stored CC product; at 12 and 18 month withdrawals, all other products rated significantly higher than this sample. For the 38°C stored CC product, a significant decrease in HS ratings occurred between the six and 12 month withdrawals. No other significant differences were noted, although the TP products generally rated higher than CC products throughout the study. From written comments it was evident at six months that, compared to other samples, a higher percentage of consumer panelists noted general off flavor, burnt flavor, and tough meat cubes in both TP and CC products stored at 38°C.

Extension of storage of the 21° heat processed products from 18 to 24 and 36 months resulted in a significant decrease in QS scores for all attributes as indicated in Appendix G. However, there were no significant changes in HS scores. All QS attribute scores and HS ratings indicated the TP product was significantly superior to the CC product across the six withdrawals over the 36 month period.

When 38°C stored products were included in the three-way analysis of variance, Appendix H, a significant decrease in all five QS attribute scores occurred between the initial evaluation and the six month withdrawal. From examination of both Appendix E and G data, this was evidently due to incremental decreases in 21°C stored product scores as well as the somewhat greater rate of decrease in 38°C stored product scores. Between 6 and 18 months, however, scores did not further decrease. HS ratings did not decrease significantly from the initial value until the 18 month withdrawal. Again, the TP product emerged significantly superior in all ratings over the CC. However, differences in storage temperature ratings were not significant for any of the QS attributes judged, but were significant for HS ratings. The reason for the former outcome appeared due to the comparable rates of decrease for 21°C and 38°C stored product in both container types.

Swiss Steak (NRDEC). Mean QS scores are given in Appendix E, Table 9. These data indicated that, over the period of the study, the TP product scored higher than the CC product at both storage temperatures. Of the stored products, the 38°C CC samples evidenced the least stability over 18 months and the PF product the greatest. In addition, the PF product was scored higher on all attributes initially and over time than the heat processed products.

As may be observed in the acceptability data, Appendix F, the PF product also rated higher initially and over the 18 month period than the heat processed products. The TP products stored at both temperatures rated higher than CC products. Ratings over time, particularly for the 21°C stored TP and CC products, varied randomly. At the initial evaluation, the PF product was rated significantly higher than the CC product assigned to 21°C storage. A likely explanation was that 25% or more of the consumer panel noted "poor texture" in their comments about the CC products. At this state of the study, the CC lots had not been subjected to storage treatment except for short term holding before the initial evaluations. At 12 months, the PF product was again rated significantly higher than the CC product stored at both temperatures; in addition, the 21°C TP product rated significantly higher than the 38°C CC product. This outcome was duplicated at 18 months. Over time, the 38°C stored CC product showed a significant decrease between six and 18 months; this may have been an artifact, however, due to the random variability in ratings over time.

Storage extension of the 21°C heat processed products to 36 months, Appendix G, produced a significant decrease in the QS attributes of flavor, texture, and overall quality between the initial evaluation and the 36 month withdrawal. Acceptability ratings however, did not change significantly over the same period. Averaged across storage time, the TP product was scored significantly higher than the CC product in flavor and overall quality; this difference was confirmed by the HS acceptability ratings.

In the three-way analysis of variance, Appendix H, the QS odor attribute scored significantly lower after the six month evaluation and thereafter, while the overall quality score decreased significantly between initial and 18 month withdrawals. At the same time, HS data were inconsistent, particularly between initial and six month evaluations. Averaged across temperature and

storage time, scores for TP product were significantly higher for all QS attributes except texture; this was corroborated in direction and significance by HS acceptability ratings. In the analysis, there was no significant storage temperature effect for QS scores, but HS scores were significantly different and favored the 21°C stored products.

Container Performance

Tray Packs. From observations given in Appendix I, it was evident that the food contact coating on the tin-free steel container for the NRDEC products performed exceptionally well. Although there was minor staining on interiors of 38°C products after 18 months storage and 21°C products after 36 months, no softening of the coating had occurred. Although no examinations of the tinplate steel tray cans used by Kraft were recorded upon receipt at NRDEC, the heating blisters evidently developed during retorting rather than during storage. This was because evidence was found of further coating deterioration or failure at both storage temperatures through the final withdrawals.

Number 10 Cans. Softening occurred in the oleoresinous lid enamel of cans used to pack the four NRDEC products as early as the six month withdrawal. It was particularly evident on lids and the headspace area on the can body under the lid seam. This defect did not seem to worsen with storage time with the beef burgundy and swiss steak items. However, with the chicken cacciatore and smoky pork items, traces of corrosion had developed on can bodies exposed to the former item for 36 months and severe enamel softening had developed on lids of cans exposed to the later item after 12 months. This suggested that this coating would not withstand attack from the wide variety of foods expected to be provided for the proposed field service system. Although the extent of softening of body enamel was minimal when in direct contact with the foods studied, it is likely that metal serving utensils would scrape off enamel when these foods are served directly from the container as envisioned in future field foodservice systems. This would be undesirable, although harmless, from a consumer viewpoint.

Containers used for the Kraft produced items generally performed well. However, the interior corrosion noted by 18 months in containers used for beef ravioli may have been the result of mechanical or machine damage to the enamel during formation of the can body. For the chicken a la king item, it was evident that an inappropriate can body coating (plain tin) had been selected for the product if it was to be subjected to long-term storage (longer than 12 months); extensive detinning had occurred by 36 months. This phenomenon, however, had no apparent effect on food technologists' scores or consumer panel ratings, either initially or over time; no comments alluding to a metallic or "tinny" character were recorded.

Aluminum Foil Pan. Observations of corrosion after 18 months in pans used to pack the NRDEC products suggested that, despite sensory evidence of the high quality and acceptability of precooked frozen compared to heat processed foods, the failure rate of these containers was too high for them to be considered seriously for use in a field foodservice system. Not only would

food quality be expected to deteriorate in corroded/pitted containers, but leaking pans during reheating and serving would also create a serious field sanitation problem.

The aluminum foil packs used by Kraft to pack its products showed no signs of deterioration over 18 months storage. They were obtained from a different supplier than the pans used for the NRDEC products. Although Kraft's were plain foil, they may have been subjected to a different fabrication process than the pans used by NRDEC, rendering Kraft's more resistant to corrosion. The foods packed in them may also have been less reactive to the aluminum material than the foods produced by NRDEC.

Bacteriological Findings

Aerobic plate count (APC) results on the nine NRDEC and Kraft-produced precooked frozen foods ranged from 10^2 to 10^4 organisms per gram, well below the 10^5 specification for Meal, Precooked Frozen (MIL-M-0013966D). Coliform counts in the Kraft products were negative. Coliform counts below specifications were found in two NRDEC foods; however, subsequent fecal coliform differentiation at 44.5°C was negative. No increases in APC or coliform counts was observed after six months of frozen storage.

SUMMARY AND CONCLUSIONS

Expected Storage Life of Products

Table 2 contains a summary of the number of months each of the nine products might be expected to hold without a significant decrease from initial ratings in quality or acceptability. All of the five process, container, and storage temperature conditions are included. Quality scale (QS) figures are "best estimates" based upon Appendix E data, which were not statistically analyzed for significant differences among withdrawals for each storage condition. Unfortunately, the other analyses omitted the frozen product, as previously indicated, and the main effects are averaged across other independent variables. In the case of Appendix G, the time effect is averaged across both Tray Pack and the cylindrical no. 10 can; in Appendix H, this effect is averaged across both container and storage temperature. The hedonic scale data were reanalyzed for purposes of this report to include all possible pairwise comparisons for each food as previously described. Thus, the storage life estimate here is based upon statistical probability from the post-hoc analyses. For the QS data, a "rule of thumb" was used for each of the five storage conditions, i.e., approximately a one scale point decrease in the flavor and overall quality scores from the initial score was taken as evidence of significant deterioration in product quality and reason to question a product's serviceability. With HS ratings, the decision rule was a significant decrease from the initial rating at $P < 0.05$. For both sensory assessments, the figure in the Table is the withdrawal preceding the one where the observed or significant decrease occurred.

In general, the storage life estimates with the QS data were more conservative than or the same number of months as the HS data. This is expected inasmuch as the technologist judges are oriented to changes in quality and are presumably more sensitive to such changes compared to consumer panelists who are oriented to expressing level of liking or disliking, and who have not been trained or instructed in food judging. Accordingly, the QS data may be useful in indicating when under each storage condition an inspection should be conducted, and the HS data would suggest the length of storage under each condition the product would be expected to retain its acceptability to the end user (consumer).

For all precooked frozen (PF) products, both QS and HS data suggested they would be stable for the 18 month term of the study, and perhaps longer if storage was extended. QS ratings of the heat processed products stored at 21°C suggested that, of the nine evaluated, seven of the TP products had a storage life greater than or equal to that of the CC packed products. The other two CC packed products, beef stew and creamed chicken, evidenced a longer storage life than their TP counterparts. HS data for this temperature series indicated no significant decreases in ratings between initial and the final 36 month evaluation, although it should be noted that initial ratings for the chili con carne product in both container types were low and increased on subsequent withdrawals. Reasons for this "reverse order phenomenon" were not clear, but may have been attributable to blending or diminution of

TABLE 2. Expected Months Storage Life for Nine Entree Items Subjected to Five Process/Container/Storage Temperature Conditions.¹

<u>Food Product</u>	<u>Source</u>	<u>Precooked Frozen</u>		<u>Cylindrical (No. 10) Cans</u>		<u>Tray Pack</u>	
		<u>-18°C</u>		<u>21°C</u>		<u>38°C</u>	
		<u>QS</u>	<u>HS</u> ¹	<u>QS</u>	<u>HS</u>	<u>QS</u>	<u>HS</u>
Beef Burgundy	NRDEC	12	18	24	36	6	18
Beef Ravioli	Kraft	18	18	36	36	18	18
Beef Stew	Draft	18	18	36	36	12	18
Chicken Cacciatore	NRDEC	18	18	12	36	12	12
Chili Con Carne	Kraft	18	18	36	36	18	18
Creamed Chicken	Kraft	18	18	36	36	6	18
Macaroni and Cheese	Kraft	18	18	36	36	6	18
Smoky Pork	NRDEC	18	18	12	36	6	6
Swiss Steak	NRDEC	18	18	18	36	18	12

¹QS refers to food technologists' quality scale judgments; HS refers to consumers' hedonic scale judgments of acceptability.

intensity of the flavoring ingredients over time. In addition, ratings for the macaroni and cheese product, as previously indicated, were considered low initially. Inasmuch as consumer panelists typically do not use HS categories expressing strong degrees of dislike, there was little downward movement in ratings.

Of the heat processed products that were storage temperature stressed at 38°C, QS data indicated that expected storage life of seven of the CC products was less than or equal to their TP counterparts. On the other hand, beef ravioli and beef stew products indicated the reverse, beef stew being consistent with its counterpart stored at 21°C. Range of storage was 6 to 18 months for both CC and TP products. HS data suggested, that from a consumer acceptability standpoint, a longer usable life might be the case for both CC and TP products. Here also, all but two of the TP products, beef ravioli and beef stew, could be considered to have a usable life equal to or greater than the CC products. The fact that TP products required less heat processing to achieve commercial sterility may account for the observation that some foods have a longer serviceable storage life potential under stressful temperature conditions than their CC counterparts.

Rank Sensory Comparison of Precooked Frozen and Heat Processed Products for Overall Quality and Acceptability

One objective of this study was to determine which, if any, of the three processing and packaging procedures studied would yield the best product from technical quality and acceptability viewpoints. Therefore, Table 3 was constructed to summarize QS and HS data for the nine entree products evaluated. Means were computed and ranks assigned as indicated in the footnotes. The statistical significance of differences between mean values was not computed inasmuch as the statistical analyses used for QS and HS data did not provide a post-hoc Duncan or Newman-Keuls computation when means for all three treatments (PF, TP, CC) were averaged across the four storage withdrawals.

Table 3 indicates that eight out of nine PF and TP products received adjacent ranks 1 or 2 on at least one of the rating scales. This observation suggested that the TP items were perceived by technologist judges and consumer panelists alike as more comparable to PF products than the conventionally heat processed CC products. In addition, the PF version of seven out of the nine items emerged as highest rated on at least one rating scale; for three foods, both rating scales indicated the PF version was highest in quality and acceptability. Excepting the macaroni and cheese product on both rating scales and HS ratings for the beef stew item, the TP products were rated higher than the CC products. This was clear and consistent evidence of the superiority of the Tray Pack configuration for multipleserving of heat-processed entrees.

TABLE 3. Means and Ranks for Overall Quality and Acceptability¹

Product	Overall Quality (QS)			Acceptability (HS)		
	PF	TP	CC	PF	TP	CC
Beef Burgundy (NRDEC)	6.3(1) ²	6.1(2)	5.8(3)	6.5(2)	7.0(1)	6.3(3)
Beef Ravioli (Kraft)	5.7(3)	6.2(1)	6.0(2)	5.6(2)	6.0(1)	5.6(2)
Beef Stew (Kraft)	6.6(1)	6.2(2)	5.8(3)	7.1(1)	6.0(3)	6.1(2)
Chicken Cacciatore (NRDEC)	5.4(2)	5.7(1)	5.2(3)	6.4(1)	5.8(2)	5.6(3)
Chili con Carne (Kraft)	5.8(2)	6.0(1)	5.8(2)	6.3(1)	6.0(2)	5.4(3)
Creamed Chicken (Kraft)	6.4(1)	6.1(2)	5.3(3)	5.8(3)	6.0(1)	5.9(2)
Macaroni and Cheese (Kraft)	6.1(1)	4.8(3)	5.6(2)	6.2(1)	5.0(3)	5.4(2)
Smoky Pork (NRDEC)	6.1(2)	6.2(1)	5.6(3)	6.1(2)	6.4(1)	6.0(3)
Swiss Steak (NRDEC)	6.4(1)	6.2(2)	5.7(3)	6.8(1)	6.4(2)	5.8(3)

¹Means computed across four (4) trials - initial evaluation and withdrawals at 6, 12 and 18 months. Storage temperature for heat processed (TP and CC) products was 21°C.

²Numbers in parentheses are ranks. Means are ranked from highest to lowest ratings.

Container Performance During Storage

The interior coating of the tin-free steel Tray Packs used in production of the NRDEC products was clearly the most stable of the food contact surfaces seen in this study. It survived retorting and subsequent storage at stressful and ambient temperature storage. Performance of the oleoresinous (C-enamel) coating used in the NRDEC no. 10 cans was variable, indicating a lack of stability during storage exposure to certain foods. The aluminum foil pan was the least satisfactory of the containers since, after 18 months of frozen storage of certain foods, corrosion and pitting was observed, indicating failure under anticipated conditions of use.

Bacteriological Tests

Both NRDEC and Kraft-produced foods processed in tray and cylindrical cans were completely sterile, i.e., beyond commercial sterility, which requires that food-borne pathogens be destroyed. This finding pertained to both the initially produced items subjected to 10 to 12 days incubation and the product withdrawn from storage after six months at 21°C and 38°C. This was clear evidence not only of the adequacy of the heat process but also of an additional margin of safety compared to precooked frozen foods.

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Appendix A. Label Declarations for Entrees Produced by Kraft

BEEF STEW

<u>Kraft-Pan</u>	<u>#10 Can</u>	<u>Frozen</u>
*Gravy	Beef	Water
Beef	Potatoes	Beef
Potatoes	Water	Beef Drippings
Carrots	Carrots	Potatoes
Peas	Peas	Carrots
Onions	Tomato Puree	Celery
- - - - -	Dehydrated Onion	Onion
	Flour	Beef Fat
	Salt	Peas
*Beef Broth & Water	Hydrolyzed Vegetable Protein	Food Starch-Modified
Food Starch-Modified	Monosodium Glutamate	Potato Flour
Salt	Caramel Color, Flavoring	Hydrolyzed Vegetable
Hydrolyzed Vegetable Protein		Salt
Monosodium Glutamate		Monosodium Glutamate
Tomato Paste		**Imitation Beef Flavor
Sugar		Caramel Color
Spice		Spices
Paprika		Oleoresin Paprika
Artificial Color		Citric Acid
Onion		- - - - -
Garlic		
Natural Flavor		**Hydrolyzed Vegetable
		Protein
		Monosodium Glutamate
		Hydrogenated Vegetable Fat
		Autolyzed Yeast
		Disodium Inosinate
		Disodium Guanylate

Appendix A. Label Declarations for Entrees Produced by Kraft (Cont'd)

BEEF RAVIOLI in SAUCE

Kraft-Pan

Water
Wheat Flour
Beef
Tomato Paste
Cottonseed Oil
Bread Crumbs
Salt
Sugar
Eggs
Onion
Food Starch-Modified
Hydrolyzed Vegetable Protein
Monosodium Glutamate
Spices
Garlic
Celery
Natural Flavor

#10 Can

Tomato
Water
Flour
Beef
Bread Crumbs
Sugar
Salt
Food Starch-Modified
Eggs
Egg White
Flavoring
Soybean Oil
Celery
Carrots
*Romano Cheese
Dehydrated Onion

*Made from Cow's Milk

Frozen

Water
Tomato Paste
Flour
Beef
Eggs
Cottonseed Oil
Spinach
Salt
Parmesan Cheese
Sugar
**Dehydrated Vegetables
***Hydrogenated Soybean Oil
Spices
Flavoring

**Onion
Parsley
Celery
Garlic

***with Mono and
Diglycerides

Appendix A. Label Declarations for Entrees Produced by Kraft (Cont'd)

CHILI CON CARNE with BEANS

Kraft-Pan

Water
Beef
Beans
Corn Flour
Food Starch-Modified
Spice
Hydrolyzed Vegetable Protein
Salt
Wheat Flour
Sugar
Paprika
Onion
Monosodium Glutamate
Garlic
Artificial Color
Citric Acid

#10 Can

Water
Beef
Tomato Puree
Beans
Textured Soy Flour
Cereal
*Chili Seasoning
Food Starch-Modified
Salt
Dehydrated Onions
Spices
Flavoring
Oleoresin Paprika
Monosodium Glutamate

- - - - -

*Chili Pepper
Cumin
Salt
Oregano
Garlic

Frozen

Kidney Beans
Beef
Water
Tomato Paste
Food Starch-Modified
Hydrolyzed Vegetable Protein
Chili Pepper
Salt
Sugar
Paprika
Dehydrated Onion
Flavoring
Spice
Monosodium Glutamate

Appendix A. Label Declarations for Entrees Produced by Kraft (Cont'd)

MACARONI & CHEESE

<u>Old</u> <u>Kraft-Pan 1/</u>	<u>#10 Can</u>	<u>Frozen</u>
*Cheese Sauce	***Cheese Sauce	Water
**Macaroni	**Macaroni	Cooked Macaroni
-----	-----	Cheddar Cheese
		Cottonseed Oil
		Non-Fat Dry Milk
*Water	***Water	Modified Tapioca Starch
American Cheese	Cheddar Cheese	Bread Crumbs
Butter	Butter	Sodium Phosphate
Skim Milk	Skim Milk	Parmesan Cheese
Food Starch-Modified	Food Starch-Modified	Salt
Sodium Phosphate	Sodium Phosphate	Spices
Salt	Salt	Artificial Color
Artificial Color	Sodium Hexametaphosphate	
-----	Artificial Color	

**with added Glyceryl Monostearate

1/ Aged Cheese

Appendix A. Label Declarations for Entrees Produced by Kraft (Cont'd)

Kraft-Pan
(Creamed Chicken)

Water
Chicken
Milk
Chicken Broth
Food Starch-Modified

Chicken Fat
Vegetable Oil
Wheat Flour
Mushrooms
Red Bell Peppers
Green Bell Peppers
Salt
Hydrolyzed Vegetable Protein
Onion
Lactose
Monosodium Glutamate
Sodium Caseinate
Dipotassium Phosphate
Spice
Turmeric
Garlic
Natural Flavor

#3 Can
(Chicken a la King)

Milk
Chicken Meat
Chicken Broth
Cream
Mushrooms

Flour
Red Sweet Pepper
Chicken Fat
Food Starch-Modified
Green Peppers
Salt
Monosodium Glutamate
Sugar
Flavoring

Frozen
(Chicken a la King)

Water
Chicken Meat
Chicken Broth
Food Starch-Modified
Partially Hardened Vegetable
Oil
*Vegetables
Sherry Wine
Chicken Fat
Salt
**Chicken Flavor
Lactose
Sugar
Sodium Caseinate
Monosodium Glutamate
Spice Extractives
Xanthan Gum
Dipotassium Phosphate
Spice
Tricalcium Phosphate
Disodium Inosinate
Disodium Guanylate
Natural Color

**Salt
Sugar
Chicken
Malto-Dextrin
Chicken Fat
Hydrolyzed Veg. Protein
Dehydrated Onion Flavoring
Disodium Inosinate
Disodium Guanylate
Turmeric
Oxygen Interceptor
(to preserve flavor)

*Mushrooms
Red Pepper
Onion
Green Pepper

Appendix B. Formulas and Processing Procedures for
NRDEC* Produced Entrees

1. Beef Burgundy with Rotini

Gravy formula:

	Percent
Carrots, frozen, dice	10.00
Dehydrated onion pieces, rehydrated	10.00
Mushrooms, pieces, canned	9.50
Tomato paste, 26% solids	4.00
Flour	1.50
Burgundy wine flavor, Vie-Del	3.50
Margarine	1.50
Hydrolyzed vegetable protein, Nestles 4BE	1.00
Starch*	2.50
Vinegar, cider, 40 grain	1.00
Salt	.75
Monosodium glutamate	.75
Sugar, white	.60
Celery seed, ground	.09
Black pepper	.03
Garlic powder	.02
Broth and water, 50/50	53.26
	100.00

* For heat processed products, "Clearjel" (National Starch) was used. For the precooked frozen product, "Col-Flo," same vendor, was substituted.

Procedure

All ingredients except starch, flour, carrots, burgundy flavor, and a small portion of the water were placed in a steam-jacketed kettle with agitator. A starch-flour slurry was prepared with the remaining water and added when the temperature reaches 71°C (160°F). Heating continued until the temperature reached 82°C (180°F), at which time the carrots and burgundy flavor were added. Volume was adjusted with water to original formula weight and sauce was held hot until filling (less than one hour).

* NRDEC Notebook No. 7058, 27 May 1977, pp. 6, 10, 13, and 16

Appendix B (con'd)

Meat Component

Frozen diced beef was used. For number 10 and tray can packs, beef dices were browned in a steam-jacketed kettle until all surfaces had changed color. Depending upon batch size sufficient water was added to extract broth and provide one-half of liquid requirement for the gravy. For the precooked frozen product, dices were placed with sufficient water for the broth requirement, into field pans. Pans were placed in a 177°C (350°F) bakery rotary oven and the dices cooked to finish. The oven was stopped intermittently and the cubes stirred to prevent sticking/scorching.

Fill Proportions, All Containers

	Ounces	Percent
Beef dice	35.0	33.0
Rotini, water blanched to double weight	11.0	10.4
Gravy	60.0	56.6
Total	106.0	100.0

Retorting/Freezing

Approximate fill temperature for retorted products was 49°C (120°F). Tray Packs were closed on a Callahan-AMS Machinery Co., 227 SV Vacuum Sealer. Number 10 cans were closed on an American Can Co., No. 1 Pacific SV Closing Machine. Both Tray Packs and number 10 cans were still processed in a 121°C (250°F) horizontal steam-air retort at 17-68 PSI equipped with water spray cooling. Process times were: Tray Packs - 64 minutes; number 10 cans - 225 minutes. For filled plain foil pans containing product for freezing, an Elks Plus Machinery, Inc., closing machine was used to crimp on lids. These pans were chilled, then placed in a -32°C (-20°F) blast freezer for approximately 18 hours. Pans were then moved to a -18°C (0°F) freezer for storage.

Appendix B (con'd)

2. Chicken Cacciatore

Gravy formula:

	Percent
Monosodium glutamate	1.00
Salt	1.00
Tomatoes, whole	12.00
Tomato paste, 26% solids	3.00
Starch*	3.00
Flour	1.00
Dehydrated onion pieces, rehydrated	1.91
Sugar, white	0.75
Cinnamon	.007
Stock	71.393
Burgundy wine flavor, Vie-Del	3.00
Chicken fat & emulsified turkey skins **	1.79
Garlic powder	0.02
Rosemary, ground	0.05
Celery seed, ground	0.05
Black pepper	0.03
	<hr/> 100.00

* For heat processed products, "Clearjel" was used; for precooked frozen, "Col-Flo."

** Emulsified with water in Waring Blender until skin was completely marcerated.

Procedure

All ingredients except starch, flour, burgundy flavor and a portion of water for slurry production were placed in a steam-jacketed kettle with agitator. The starch-flour slurry was added when the temperature reached 71°C (160°F). Heating continued to 82°C (160°F) and the burgundy flavor was added. Sauce was held hot for filling (less than one hour).

Meat Component

Frozen turkey breasts, bone-in, were used. The breasts were placed in roasting pans with approximately one and one-half quarts water, and covered with foil. For both precooked frozen and heat processed products, pans were placed in steamer and steamed to an internal temperature of 77°C (171°F), cooled, boned and handcut into dices.

Appendix B (con'd)

Fill Proportions

	Ounces	Percent
Turkey	42.5	40.1
Gravy	63.5	59.9

Approximate fill temperature for retorted products was 49°C (120°F).
Product for freezing was chilled before placement in blast freezer.

Retorting/Freezing

Closing machines and the retort procedure used for Tray Packs and no. 10 cans were as described for the beef burgundy item. Process times were: Tray Pack - 70 minutes; number 10 cans - 232 minutes. Procedure for the frozen product was also as described for beef burgundy.

Additional Note:

Runs were made starting with solidly frozen breasts and with previously thawed breasts. When starting with frozen breasts, average yield of cooked meat minus skins was 51.3% (3 runs); with previously thawed breasts, the average of four runs was 54.2%. Extent of drippage from thawing was not recorded but could account for the apparent increase in yield.

3. Smoky Pork

Gravy formula:

	Percent
Red peppers	0.50
Tomato paste, 26% solids	8.86
Brown sugar	3.59
Starch*	3.25
Dehydrated onion pieces, rehydrated	1.75
Cider vinegar, 40 grain	3.25
Salt	0.80
Monosodium glutamate	0.25
Liquid smoke, Red Arron	0.50
Mustard, dry	0.02
Hot sauce	0.01
Garlic powder	0.03
Allspice	0.006
Chili powder	0.05
Sugar, white	1.00
Black pepper	0.02
Flour	1.75
Cloves	0.004
Pork broth & water	94.36
	<hr/> 100.000

* For heat processed products, "Clearjel" was used; for the precooked frozen product, "Col-Flo" at 0.25% lower level was used.

Appendix B (con'd)

Procedure

All ingredients except starch, flour, smoke flavor, and an aliquot of water for starch-flour slurry preparation were combined in a steam-jacketed kettle with agitator and heated to 71°C (160°F). The starch-flour slurry was added and heating continued to 82°C (180°F) at which time the smoke flavor was added.

Meat Component

Frozen boneless butts were used. Due to high fat content, the resulting pork dice was retrimmed. Identical procedures to those used for meat component of the Beef Burgundy items were followed, both for heat processed and precooked frozen products. Meat yield, frozen butts to cooked cubes, was 60.3%.

Fill Proportions, All Containers

Pork dice were filled into containers first, then gravy. Prior to filling the frozen product, both meat and gravy components were chilled. Fill temperature for retorted products was approximately 49°C (120°F).

Proportions

	Ounces	Percent
Pork dice	53	50.0
Gravy	53	50.0
Total	106	100.0

Retorting/Freezing

Closing machines and the retort procedure used were as described for the beef burgundy item. Process times were: Tray Pack - 62 minutes; number 10 can - 223 minutes. Procedure for the frozen product was also as described for beef burgundy.

Appendix B (con'd)

4. Swiss Steak

Gravy formula:

	Percent
Celery seed, ground	0.10
Brown sugar	0.20
Garlic powder	0.31
Dehydrated onion pieces, rehydrated	9.71
Black pepper	0.07
Salt	1.23
Worcestershire sauce	1.84
Hydrolyzed vegetable protein, Nestles 4BE	0.92
Flour	1.50
Starch*	3.00
Beef broth & water, 50/50	<u>81.12</u>
	100.00

* For heat processed products, "Cleargel" was used; for the precooked frozen product, "Col-Flo" was used.

Procedure

All ingredients except starch, flour, and a small amount of water for slurry preparation were combined in a steam-jacketed kettle. When the temperature reached 71°C (160°F), the starch-flour slurry was added and heating continued to 82°C (180°F). Sauce was held hot for filling (less than one hour).

Meat Component

Swiss steaks, boneless, frozen choice, were used. They were placed in roasting pans while still frozen and approximately two quarts water added per pan for broth production. For heat processed products, pans were covered with foil and placed in a steamer and steamed until the surface pink color had disappeared (about 20 minutes). Average yield was 70.4%. For the precooked frozen product, pans were placed in a 260°C (500°F) rotary oven and baked until pieces were browned on both sides. After browning, pans were placed in the steamer for one hour to cook to finish. Average yields, 52.3%.

Filling Proportions, All Containers

	Ounces	Percent
Swiss Steak	46.25	44.3
Gravy	<u>58.00</u>	<u>55.7</u>
Total	104.25	100.0

Appendix B (con'd)

Fill weights for frozen product were the same as for heat processed products although the meat yield for frozen product was lower. Approximate fill temperature 49°C (120°F) for retorted products. Product for freezing was chilled before placement in blast freezer.

Retorting/Freezing

Closing machines and the retort procedure used were as described for the beef burgundy item. Process times were: Tray Pack - 60 minutes; number 10 can - 224 minutes. Procedure for the frozen product was also as described for beef burgundy.

Appendix C. Quality Scoring Sensory Panel Instructions, Descriptive Terms and Ingredient Declarations for Nine Entrees

COMMON INSTRUCTIONS

You will be testing a processed food similar to products prepared for institutional feeding where only heating and serving are required.

Below are descriptive phrases that may be helpful in evaluating this test product. Feel free to use your own descriptive terms for the product evaluation. The descriptions listed include: (they were then listed with an ingredient declaration for the product being evaluated).

Your rating will indicate the the quality of the product. The objective is to evaluate and describe the test product as a processed food. Your own initial description will be the basis for your future evaluations.

PRODUCT DESCRIPTIONS

Beef Burgundy with Rotini:

Appearance: large pieces of beef, browned beef, large carrot pieces, thick gravy, medium to dark gravy, oil seperation.

Odor: burgundy, browned beef, spice, onion, beef broth, sour, canned.

Flavor: burgundy, browned beef gravy, canned beef, onion, salty, sour, fatty, metallic, bitter, canned beef.

Texture: tender, stringy beef, mushy carrot, soft pasta.

The ingredients of this product are beef, rotini, carrots, dehydrated onion, mushrooms, tomato paste, flour, wine flavor, margarine, HVP, starch vinegar, salt, MSG, sugar, ground celery, pepper, garlic powder, broth.

Beef Ravioli:

Appearance: sauce-orange-red color, insufficient amount for product, slightly thick, starchy appearance; meat filling - gray brown to gray green in color.

Odor: cooked spiced tomato sauce, canned tomato paste, spice, beef, oregano.

Flavor: cooked, canned tomato paste, spice (pepper, oregano) salty, beef, metallic.

Texture: filling - moist to dry, grainy, pasta - slightly to moderately thick, tender, gummy, doughy, firm, chewy.

The ingredients of this product are tomatoes or tomato paste, water, flour, beef, bread crumbs, eggs, egg whites, sugar, salt, food starch - modified, soy bean oil, cottonseed oil, celery, carrots, spinach, parmesan or romano cheese, dehydrated onion, parsley, garlic, HVP, MSG, spices, flavoring.

Appendix C (Cont'd)

Creamed Chicken:

Appearance: sauce - pale yellow to tan orange color (like pimiento blend), smooth, slightly fluid to moderately fluid.

Odor: blended chicken broth, cream sauce, subtle seasoning, sl. cooked milk (evaporated milk), canned-scorched cream sauce, pimiento, cooked chicken, lacks chicken character.

Flavor: blended chicken broth cream sauce, subtle seasoning, cooked chicken, pimiento, green pepper, salty, slight canned scorched cream sauce, sl. cooked milk (evaporated milk), metallic.

Texture: Sauce: smooth, slightly to moderately fluid.
Chicken: tender, firm chicken pieces, chicken stringy and chewy.

The ingredients of this product are milk, chicken meat, water, chicken broth, cream, mushrooms, flour, food starch modified, red sweet peppers, green peppers, vegetable oil, salt, HVP, onion, sherry wine, chicken flavor, MSG, sugar sodium caseinate, spice, turmeric, garlic, lactose.

Macaroni and Cheese:

Appearance: light yellow-orange cheese sauce, orange bread crumbs, oil droplets, thick, fluid.

Odor: cheese, canned cheese, milk solids, scorched.

Flavor: cheese, starch, canned, bitter, metallic, scorched cheese sauce, tangy, sour.

Texture: smooth, starchy, gummy, oily, soupy, grainy cheese sauce, tangy, sour.

The ingredients of this product are water, cheddar cheese, American cheese, butter, cottonseed oil, skim milk, food starch modified, bread crumbs, sodium phosphate, salt, spices, artificial color, macaroni with added glycerol monostearate.

Smokey Pork:

Appearance: red-brown gravy, fluid gravy, excess meat fines in gravy, large pork pieces.

Odor: smoke, sweet-sour, sour, scorched, canned sauce, spicy, BBQ spice.

Flavor: sour, sweet, smoke, scorched, bitter, canned sauce, canned meat.

Texture: tender, chewy, stringy.

The ingredients in this product are pork, pork broth, tomato paste, brown sugar, starch, cider vinegar, onion, white sugar, flour, red dehydrated

Appendix C (Cont'd)

peppers, salt, MSG, liquid smoke, dry mustard, hot sauce, garlic powder, allspice, chili powder, black pepper, ground cloves.

Swiss Steak:

Appearance: Gravy - medium brown color, moderately fluid, onion pieces.
Meat - light tan to moderate red-brown color, fibrous when cut, stringy appearance.

Odor: beef gravy, onion, spice, sweet.

Flavor: onion, beef broth, salt, pepper, cooked beef, spice, sweet.

Texture: Gravy - sl. fluid.
Meat - dry, stringy, fibrous.

The ingredients for this product are water, U.S. Choice beef, beef broth, dehydrated onion, food starch modified, Worcestershire sauce, flour, salt, HVP, garlic powder, brown sugar, ground celery seed.

[illegible]

Appendix E. Mean Quality Scores for Nine Entrees

Appendix E-1 Mean Quality Scores, Beef Burgundy with Rotini (NRDEC)

Attribute			Tray Pack (TP)		No. 10 Can (CC)		Precooked
			21°C	38°C	21°C	38°C	Frozen (PF) -18°C
	Months	No. Panelists	Mean Scores				
Appearance	0	20	6.0	6.3	6.6	6.5	6.3
	6	17	6.3	6.5	6.2	6.2	6.3
	12	16	6.7	6.7	5.9	6.2	6.4
	18	16	6.5	6.4	6.1	6.0	6.0
	24	11	6.5		6.4		
	36	12	6.7		5.9		
Odor	0	20	6.1	6.1	6.6	6.4	6.5
	6	17	6.6	6.3	6.1	5.9	6.4
	12	16	6.3	6.0	6.1	5.5	6.4
	18	16	6.2	6.0	5.9	5.2	6.0
	24	11	6.1		6.0		
	36	12	6.3		5.7		
Flavor	0	20	5.9	6.1	6.6	6.6	6.6
	6	17	6.5	6.2	5.9	5.4	6.4
	12	16	6.3	5.9	5.7	5.2	6.6
	18	16	6.3	5.4	5.3	5.1	6.0
	24	11	5.7		5.4		
	36	12	6.5		5.2		
Texture	0	20	6.2	6.0	6.3	6.3	6.4
	6	17	6.1	6.3	6.0	5.9	6.3
	12	16	6.0	5.8	6.0	5.6	6.7
	18	16	5.9	5.3	5.4	5.3	6.3
	24	11	5.8		6.0		
	36	12	5.7		5.4		
Overall Quality	0	20	5.8	6.1	6.3	6.3	6.5
	6	17	6.4	6.1	5.9	5.6	6.4
	12	16	6.2	5.8	5.6	5.2	6.4
	18	16	6.0	5.4	5.3	4.9	5.9
	24	11	5.8		5.5		
	36	12	6.1		5.0		

Appendix E-2. Mean Quality Scores, Beef Ravioli (Kraft)

Attribute			Tray Pack (TP)		No. 10 Can (CC)		Precooked
			21°C	38°C	21°C	38°C	Frozen (PF) -18°C
	Months	No. Panelists	Mean Scores				
Appearance	0	19	6.5	5.9	6.7	6.8	5.5
	6	16	6.7	6.6	6.5	6.7	5.9
	12	18	6.9	6.8	6.7	6.6	5.6
	18	18	6.1	6.6	6.7	6.4	5.8
	24	14	6.7		6.4		
	36	13	7.0		6.5		
Odor	0	20	6.5	6.4	6.7	6.5	6.7
	6	17	6.6	6.6	6.5	6.6	6.5
	12	18	6.6	6.6	6.3	6.3	6.4
	18	19	6.7	6.6	6.5	6.5	6.4
	24	14	6.5		6.4		
	36	15	6.7		6.7		
Flavor	0	20	6.3	5.7	6.3	6.1	6.0
	6	17	6.2	6.0	5.8	5.9	6.1
	12	18	6.3	5.8	5.8	5.4	6.0
	18	19	6.4	6.2	5.8	5.0	5.8
	24	14	6.1		5.8		
	36	15	5.9		6.2		
Texture	0	20	6.5	6.3	5.8	6.0	6.0
	6	17	6.4	6.5	5.7	5.8	6.1
	12	18	6.6	6.3	5.9	5.7	5.6
	18	19	6.3	6.4	5.6	5.7	5.7
	24	14	6.1		5.6		
	36	15	6.1		5.9		
Overall Quality	0	20	6.1	5.9	6.4	6.1	5.8
	6	17	6.3	6.1	5.8	6.0	6.1
	12	18	6.2	6.1	5.9	5.6	5.6
	18	19	6.3	6.3	5.8	5.6	5.4
	24	14	6.1		5.7		
	36	15	6.1		6.3		

Appendix E-3. Mean Quality Scores, Beef Stew (Kraft)

Attribute			Tray Pack (TP)		No. 10 Can (CC)		Precooked
			21°C	38°C	21°C	38°C	Frozen (PF) -18°C
	Months	No. Panelists	Mean Scores				
Appearance	0	20	6.9	7.1	6.5	6.4	6.1
	6	19	6.7	6.9	6.9	6.4	6.3
	12	16	6.7	6.7	6.2	6.4	6.6
	18	19	6.6	6.5	6.5	6.1	5.9
	24	12	6.9		6.4		
	36	12	6.6		6.6		
Odor	0	20	6.6	6.4	6.5	6.6	6.8
	6	19	6.4	6.4	6.4	6.1	6.7
	12	16	6.4	5.8	5.7	5.6	7.0
	18	19	6.2	5.7	5.8	5.4	6.8
	24	12	6.0		5.7		
	36	12	5.7		6.3		
Flavor	0	20	6.6	6.5	6.0	5.9	6.9
	6	19	6.5	6.1	6.1	5.3	6.7
	12	16	6.1	5.4	5.3	5.2	7.3
	18	19	5.9	5.3	5.7	4.8	6.8
	24	12	5.9		5.3		
	36	12	5.0		5.6		
Texture	0	20	6.4	6.5	6.4	6.2	6.3
	6	19	6.4	6.2	6.4	6.3	6.7
	12	16	6.2	5.7	6.3	6.2	6.8
	18	19	5.9	5.7	6.1	6.1	6.4
	24	12	5.7		6.0		
	36	12	5.4		6.2		
Overall Quality	0	20	6.3	6.5	6.2	5.7	6.3
	6	19	6.3	6.0	6.1	5.4	6.7
	12	16	6.3	5.3	5.4	5.5	7.0
	18	19	6.0	5.2	5.6	5.2	6.6
	24	12	6.0		5.5		
	36	12	5.0		5.6		

Appendix E-4. Mean Quality Scores, Chicken Cacciatore (NRDEC)

Attribute			Tray Pack (TP)		No. 10 Can. (CC)		Precooked
			21°C	38°C	21°C	38°C	Frozen (PF) -18°C
	Months	No. Panelists	Mean Scores				
Appearance	0	20	6.4	6.4	6.3	6.2	5.9
	6	17	5.9	5.9	5.6	5.6	5.2
	12	17	6.0	6.1	5.9	5.6	5.8
	18	17	6.2	5.5	5.5	4.9	5.6
	24	13	5.8		5.1		
	36	11	5.7		5.3		
Odor	0	20	6.3	6.3	6.1	6.0	5.9
	6	17	5.7	5.7	5.4	5.4	5.5
	12	17	6.1	5.6	5.2	5.2	5.9
	18	17	5.6	5.3	5.2	4.5	5.4
	24	13	5.4		5.1		
	36	11	5.4		4.8		
Flavor	0	20	6.1	6.0	5.7	5.3	5.8
	6	17	5.3	5.2	5.2	4.9	5.1
	12	17	5.8	5.4	4.9	4.4	5.3
	18	17	5.4	4.7	4.5	3.8	5.4
	24	13	5.4		4.6		
	36	11	5.0		4.1		
Texture	0	20	5.8	6.0	5.9	6.0	6.1
	6	17	5.5	5.3	5.1	5.2	5.7
	12	17	5.7	5.3	5.3	4.9	5.6
	18	17	5.5	5.0	5.2	4.5	5.7
	24	13	5.0		5.0		
	36	11	4.6		4.5		
Overall Quality	0	20	6.1	6.0	5.8	5.4	5.7
	6	17	5.5	5.3	5.2	4.9	4.9
	12	17	5.8	5.4	5.0	4.5	5.2
	18	17	5.4	4.9	4.6	4.1	5.4
	24	13	5.3		4.7		
	36	11	4.9		4.2		

Appendix E-5. Mean Quality Scores, Chili con Carne (Kraft)

Attribute			Tray Pack (TP)		No. 10 Can (CC)		Precooked
			21°C	38°C	21°C	38°C	Frozen (PF) -18°C
	Months	No. Panelists	Mean Scores				
Appearance	0	20	6.1	6.1	6.3	5.9	6.7
	6	17	6.3	6.6	6.2	6.3	6.7
	12	17	6.0	6.2	6.2	5.9	6.6
	18	17	6.2	6.0	6.0	5.9	6.4
	24	13	6.3		5.9		
	36	11	6.5		6.2		
Odor	0	20	6.6	6.5	6.3	6.6	6.3
	6	17	6.6	6.6	6.2	6.2	6.2
	12	17	6.4	6.3	6.4	5.9	6.2
	18	17	6.1	5.8	6.1	5.7	6.2
	24	13	6.1		5.9		
	36	11	6.4		5.8		
Flavor	0	20	6.3	6.4	5.7	5.5	5.6
	6	17	6.2	6.2	5.7	5.6	5.8
	12	17	5.9	5.6	5.8	5.2	5.6
	18	17	5.9	4.6	5.7	5.4	5.7
	24	13	5.8		4.9		
	36	11	5.9		5.5		
Texture	0	20	6.3	6.4	6.6	6.6	6.8
	6	17	6.4	6.4	6.4	6.5	6.5
	12	17	6.5	6.2	6.5	6.1	6.6
	18	17	5.9	5.6	6.1	6.2	6.1
	24	13	6.3		6.0		
	36	11	6.0		6.2		
Overall Quality	0	20	6.0	6.2	5.9	5.6	5.9
	6	17	6.2	6.1	5.8	5.8	5.9
	12	17	5.9	5.6	5.8	5.3	5.8
	18	17	6.1	4.9	5.8	5.4	5.5
	24	13	5.8		5.1		
	36	11	6.1		5.5		

Appendix E-6. Mean Quality Scores, Creamed Chicken (Kraft)

Attribute			Tray Pack (TP)		No. 10 Can (CC)		Precooked Frozen (PF)
			21°C	38°C	21°C	38°C	-18°C
	Months	No. Panelists	Mean Scores				
Appearance	0	19	6.4	6.2	5.5	5.7	6.6
	6	17	6.3	5.8	5.6	4.8	6.6
	12	14	6.1	4.9	5.6	4.6	6.6
	18	16	6.1	4.8	5.7	4.2	6.6
	24	16	6.1		5.6		
	36	11	5.9		6.0		
Odor	0	20	6.4	6.5	5.5	5.5	6.5
	6	18	6.3	5.7	5.4	4.9	6.5
	12	14	6.2	5.4	5.4	4.9	6.4
	18	16	6.0	4.9	5.3	4.6	6.4
	24	16	6.1		5.6		
	36	11	5.9		5.4		
Flavor	0	20	6.3	6.5	5.3	5.4	6.6
	6	18	6.3	5.5	5.2	4.9	6.6
	12	14	6.1	4.7	5.2	4.3	6.5
	18	16	5.7	4.4	5.4	4.4	6.6
	24	16	5.7		5.4		
	36	11	5.4		5.2		
Texture	0	20	6.0	6.3	5.8	5.7	6.8
	6	18	6.4	5.9	5.9	4.8	6.7
	12	14	6.2	5.4	6.2	4.9	6.6
	18	16	6.2	5.1	5.7	5.0	6.3
	24	16	5.4		5.6		
	36	11	5.2		5.6		
Overall Quality	0	20	6.3	6.3	5.4	5.3	6.6
	6	18	6.2	5.4	5.3	4.4	6.4
	12	14	6.1	4.5	5.4	4.2	6.5
	18	16	5.8	4.4	5.1	4.2	6.3
	24	16	5.6		5.4		
	36	11	5.3		5.3		

Appendix E-7. Mean Quality Scores, Macaroni and Cheese (Kraft)

Attribute			Tray Pack (TP)		No. 10 Can (CC)		Precooked
			21°C	38°C	21°C	38°C	Frozen (PF) -18°C
	Months	No. Panelists	Mean Scores				
Appearance	0	20	5.6	5.5	5.4	5.1	6.6
	6	16	5.7	5.3	6.0	5.6	6.5
	12	17	5.6	4.9	5.9	4.6	6.6
	18	15	5.5	4.1	5.7	3.5	6.7
	24	16	5.5		5.5		
	36	-	-		-		
Odor	0	20	5.4	5.6	6.0	5.8	6.6
	6	16	5.4	5.2	6.1	5.9	6.1
	12	17	5.2	5.1	5.8	5.2	6.5
	18	15	5.3	4.9	5.8	4.3	6.2
	24	16	5.4		5.6		
	36	-	-		-		
Flavor	0	20	4.7	4.9	5.8	5.8	6.1
	6	16	4.7	4.2	5.7	5.2	6.2
	12	17	4.6	4.5	5.8	4.8	6.4
	18	15	4.7	3.8	5.3	3.4	5.8
	24	16	4.6		5.1		
	36	-	-		-		
Texture	0	20	5.8	5.8	5.9	5.8	6.3
	6	16	5.9	5.7	6.1	5.7	5.8
	12	17	5.9	6.1	6.1	5.9	6.2
	18	15	6.0	5.7	5.9	5.4	5.9
	24	16	5.9		5.9		
	36	-	-		-		
Overall Quality	0	20	4.9	5.2	5.6	5.5	6.0
	6	16	4.9	4.3	5.9	5.2	6.0
	12	17	4.6	4.8	5.8	4.7	6.5
	18	15	4.7	3.8	5.2	3.1	5.8
	24	16	4.9		5.1		
	36	-	-		-		

Appendix E-8. Mean Quality Scores, Smoky Pork (NRDEC)

Attribute			Tray Pack (TP)		No. 10 Can (CC)		Precooked
			21°C	38°C	21°C	38°C	Frozen (PF) -18°C
	Months	No. Panelists	Mean Scores				
Appearance	0	19	6.4	6.5	6.4	6.7	5.6
	6	17	5.8	6.3	5.6	5.6	5.9
	12	14	6.2	6.3	5.3	5.9	5.2
	18	12	6.7	6.3	5.7	5.1	5.7
	24	10	6.1		5.5		
	36	12	6.3		5.5		
Odor	0	20	6.7	6.7	6.5	6.7	6.6
	6	17	6.6	6.4	5.8	5.5	6.6
	12	14	6.2	6.1	5.6	5.6	6.1
	18	12	6.5	6.3	5.6	5.3	6.2
	24	10	5.8		5.3		
	36	12	6.2		5.7		
Flavor	0	20	6.5	6.6	6.2	6.4	6.4
	6	17	6.4	6.2	5.5	5.2	6.7
	12	14	6.1	5.8	5.2	4.9	6.1
	18	12	6.3	5.7	5.2	4.6	6.2
	24	10	5.4		4.9		
	36	12	5.9		5.2		
Texture	0	20	6.7	6.7	6.3	6.4	6.6
	6	17	6.2	6.1	5.8	5.5	6.8
	12	14	6.0	5.8	5.6	5.1	6.4
	18	12	6.2	5.8	5.4	5.1	6.6
	24	10	5.7		5.2		
	36	12	5.8		5.4		
Overall Quality	0	20	6.4	6.6	6.1	6.4	6.1
	6	17	6.1	6.3	5.4	5.2	6.7
	12	14	6.1	5.6	5.4	5.0	5.7
	18	12	6.3	5.8	5.3	4.7	6.0
	24	10	5.5		5.0		
	36	12	5.7		5.1		

Appendix E-9. Mean Quality Scores, Swiss Steak (NRDEC)

Attribute			Tray Pack (TP)		No. 10 Can (CC)		Precooked
			21 ^o C	38 ^o C	21 ^o C	38 ^o C	Frozen (PF) -18 ^o C
	Months	No. Panelists	Mean Scores				
Appearance	0	17	6.4	6.8	6.6	6.3	6.4
	6	16	6.7	6.6	6.6	6.5	6.1
	12	14	6.6	6.7	6.3	6.1	6.5
	18	14	6.8	6.5	6.6	6.5	6.7
	24	9	6.8		6.4		
	36	12	6.6		6.3		
Odor	0	27	6.8	6.6	6.6	6.6	6.9
	6	16	6.3	6.4	6.1	6.1	6.4
	12	14	6.5	6.4	6.2	6.1	6.6
	18	14	6.5	6.0	6.0	6.1	6.8
	24	9	6.6		6.3		
	36	12	6.3		6.2		
Flavor	0	27	6.1	6.1	6.1	5.7	6.7
	6	16	6.3	6.2	5.6	5.7	6.3
	12	14	6.6	6.4	5.6	4.9	6.7
	18	14	6.1	5.6	5.4	5.2	7.1
	24	9	5.4		5.0		
	36	12	5.6		5.0		
Texture	0	27	6.0	6.5	6.2	5.8	6.4
	6	16	5.9	5.6	5.7	5.7	6.0
	12	14	6.1	6.1	6.3	5.9	6.7
	18	14	6.1	5.4	5.9	5.8	6.8
	24	9	5.8		5.3		
	36	12	5.2		5.5		
Overall Quality	0	27	6.2	6.3	6.0	5.8	6.5
	6	16	6.1	5.9	5.7	5.6	6.1
	12	14	6.4	6.1	5.5	5.0	6.5
	18	14	6.0	5.5	5.5	5.2	6.7
	24	9	6.0		5.1		
	36	12	5.7		5.1		

Appendix F. Hedonic Scale Acceptability Data for Nine Entrees⁽¹⁾

Product	Storage Time (Months)	Precooked Frozen (PC)	No. 10 Can (CC)		Tray Pack (TP)	
		(-18°C)	(21°C)	(38°C)	(21°C)	(38°C)
Beef Burgundy with Rotini (NRDEC)	0	6.1 + 2.0	6.6 + 1.9	6.3 + 1.4	7.0 + 1.4	6.9 + 1.2
	6	7.1 + 1.6	6.2 + 2.3	6.3 + 1.8	7.0 + 1.7	7.1 + 1.7
	12	6.7 + 1.4	5.8 + 2.0	6.1 + 2.1	6.8 + 1.5	6.7 + 1.4
	18	6.2 + 2.1	6.7 + 1.2	5.8 + 1.7	7.1 + 1.1	6.3 + 1.1
	24		6.4 + 1.9		7.3 + 1.5	
	36		6.8 + 1.4		7.1 + 1.4	
Beef Ravioli (Kraft)	0	5.4 + 2.3	5.4 + 1.8	5.7 + 1.6	6.4 + 1.5	6.3 + 1.6
	6	5.6 + 2.2	5.8 + 2.0	5.8 + 1.8	6.1 + 1.9	6.0 + 1.5
	12	5.8 + 2.2	5.2 + 1.9	5.1 + 2.2	5.5 + 1.9	5.4 + 1.9
	18	5.8 + 2.4	5.9 + 1.8	5.6 + 2.2	5.9 + 2.0	4.7 + 2.5
	24		6.2 + 1.6		6.8 + 1.1	
	36		6.2 + 2.0		6.5 + 1.5	
Beef Stew (Kraft)	0	6.7 + 1.7	6.2 + 2.2	5.8 + 2.4	6.1 + 2.0	6.1 + 1.8
	6	7.2 + 1.5	5.7 + 1.7	5.1 + 2.1	6.1 + 1.9	5.9 + 1.8
	12	6.9 + 2.0	6.2 + 1.7	5.8 + 1.8	5.8 + 1.6	5.8 + 1.7
	18	7.4 + 1.2	6.1 + 1.9	5.4 + 1.9	6.1 + 1.3	4.9 + 1.8
	24		6.3 + 1.7		6.6 + 1.8	
	36		6.2 + 1.7		6.1 + 1.6	
Chicken Cacciatore (NRDEC)	0	5.9 + 2.0	5.9 + 2.0	5.5 + 1.8	6.0 + 1.7	5.9 + 1.8
	6	6.6 + 1.5	5.6 + 1.9	4.9 + 2.1	5.5 + 1.5	5.1 + 1.5
	12	6.3 + 1.8	5.3 + 2.2	4.6 + 1.7	5.8 + 1.7	5.1 + 1.6
	18	6.7 + 1.7	5.4 + 2.2	4.3 + 2.1	5.7 + 1.8	4.9 + 2.0
	24		6.1 + 1.5		6.4 + 1.6	
	36		5.4 + 2.0		5.3 + 2.2	
Chili Con Carne with Beans (Kraft)	0	6.4 + 2.2	5.0 + 2.4	5.4 + 2.2	5.7 + 2.1	6.1 + 1.9
	6	6.2 + 1.9	5.5 + 2.2	5.3 + 2.2	6.2 + 1.5	6.2 + 1.6
	12	6.4 + 2.0	4.7 + 2.6	4.4 + 2.2	5.7 + 1.8	5.1 + 2.1
	18	6.3 + 1.8	6.3 + 1.6	5.6 + 2.1	6.3 + 1.8	5.6 + 1.8
	24		6.3 + 1.9		6.4 + 1.7	
	36		6.1 + 1.6		6.3 + 1.7	

Appendix F. Hedonic Scale Acceptability Data for Nine Entrees⁽¹⁾

Product	Storage Time (Months)	Precooked Frozen (PC)	No. 10 Can (CC)		Tray Pack (TP)	
		(-18°C)	(21°C)	(38°C)	(21°C)	(38°C)
Creamed Chicken (Kraft)	0	4.8 + 2.6	5.1 + 2.2	5.7 + 2.1	5.9 + 1.8	5.7 + 2.1
	6	5.5 + 2.4	6.3 + 2.1	5.2 + 1.9	6.0 + 1.8	5.5 + 2.0
	12	6.7 + 2.0	6.2 + 1.5	5.1 + 2.0	6.2 + 1.7	5.4 + 2.0
	18	6.2 + 1.8	5.9 + 1.6	4.7 + 1.8	6.1 + 1.5	4.7 + 1.7
	24		6.6 + 1.8		6.8 + 1.6	
	36		6.6 + 2.0		6.2 + 1.7	
Macaroni and Cheese (Kraft)	0	6.0 + 1.8	5.5 + 1.9	5.7 + 1.9	4.8 + 2.1	4.8 + 2.3
	6	6.4 + 1.8	5.2 + 2.1	5.3 + 2.1	5.0 + 2.2	4.7 + 2.0
	12	6.4 + 1.8	5.2 + 2.3	4.9 + 2.3	4.7 + 1.9	4.1 + 1.8
	18	6.1 + 2.3	5.5 + 2.0	4.8 + 1.9	5.4 + 2.1	4.2 + 2.0
	24		5.6 + 2.0		5.1 + 2.1	
	36		5.1 + 2.0		4.7 + 2.2	
Smoky Pork (NRDEC)	0	6.0 + 1.8	5.8 + 1.9	6.3 + 1.5	6.6 + 1.1	6.0 + 1.6
	6	6.1 + 2.1	6.5 + 1.6	5.5 + 2.0	6.5 + 1.7	6.4 + 1.5
	12	5.9 + 2.0	6.0 + 1.7	4.6 + 1.9	6.4 + 1.6	5.6 + 2.0
	18	6.4 + 1.6	5.8 + 1.9	4.5 + 1.8	6.0 + 1.7	5.5 + 1.7
	24		6.0 + 1.7		6.4 + 1.6	
	36		5.5 + 1.8		6.7 + 1.3	
Swiss Steak (NRDEC)	0	6.0 + 1.8	5.8 + 1.9	6.3 + 1.5	6.6 + 1.1	6.0 + 1.6
	6	6.1 + 2.1	6.5 + 1.6	5.5 + 2.0	6.5 + 1.7	6.4 + 1.5
	12	5.9 + 2.0	6.0 + 1.7	4.6 + 1.9	6.4 + 1.6	5.6 + 2.0
	18	6.4 + 1.6	5.8 + 1.9	4.5 + 1.8	6.0 + 1.7	5.5 + 1.7
	24		6.0 + 1.7		6.4 + 1.6	
	36		5.5 + 1.8		6.7 + 1.3	

(1) Significant row (container/storage) and column (storage time) differences, $P \leq 0.05$, are discussed in the Results and Discussion section for each food.

Appendix G. Quality Evaluation and Consumer Acceptance, Two-Factor Analysis of Variance for Nine Heat Processed Entrees Stored up to 36 Months at 21°C (Scales 1 to 9)

Technologists' Quality Scale Rating ¹							Consumer Panelists Acceptability ¹	
Food Name/ Variable (b)	No. of Judge- ments	Appear- ance	Odor	Flavor	Texture	Overall Quality	No. of Judge- ments	Hedonic Scale Rating
<u>Beef Burgundy with Rotini</u>								
Storage Time, Months								
0	40	6.3±0.7 a	6.3±0.9 a	6.3±1.0 a	6.3±1.0 a	6.1±1.0 a	70	6.6±1.9 a
6	34	6.5±0.8 a	6.4±1.0 a	6.2±1.0 a	6.1±0.9 ab	6.1±0.9 a	70	6.6±2.1 a
12	32	6.3±0.7 a	6.2±1.1 a	6.0±1.3 a	6.0±1.0 ab	5.9±1.1 a	70	6.3±1.8 a
18	32	6.3±0.6 a	6.0±0.7 a	5.8±1.2 a	5.6±0.9 b	5.7±1.0 a	70	6.9±1.2 a
24	22	6.4±0.6 a	6.0±0.8 a	5.5±1.0 a	5.9±0.6 ab	5.6±0.8 a	70	6.9±1.7 a
36	24	6.3±0.9 a	6.0±1.0 a	5.9±1.1 a	5.6±0.6 b	5.5±1.0 a	70	6.9±1.4 a
Container, Tray Pack	92	6.5±0.7 a	6.3±0.9 a	6.2±1.0 a	6.0±0.9 a	6.1±0.9 a	210	7.0±1.5 a
No. 10 Can	92	6.2±0.7 b	6.1±0.9 a	5.8±1.2 b	5.9±0.9 a	5.7±1.0 b	210	6.4±1.8 b
<u>Beef Ravioli</u>								
Storage Time, Months								
0	39	6.6±0.7 a	6.6±0.7 a	6.3±0.7 a	6.2±1.1 a	6.3±1.0 a	70	5.9±1.7 b
6	34	6.6±0.7 a	6.5±0.6 a	6.0±0.9 a	6.1±0.8 a	6.1±0.8 a	70	5.9±1.9 b
12	36	6.8±0.6 a	6.4±0.7 a	6.1±1.2 a	6.2±1.0 a	6.0±1.1 a	70	5.4±1.9 b
18	38	6.7±0.6 a	6.6±0.6 a	6.1±0.9 a	5.9±0.9 a	6.1±0.8 a	70	5.9±1.8 b
24	28	6.5±0.6 a	6.4±0.6 a	6.0±0.8	5.8±0.9 a	5.9±0.8 a	70	6.5±1.4 a
36	30	6.7±0.6 a	6.7±0.6 a	6.1±0.9 a	6.0±0.7 a	6.2±0.8 a	70	6.5±1.7 a
Container, Tray Pack	103	6.7±0.5 a	6.6±0.6 a	6.2±1.0 a	6.3±0.8 a	6.2±1.0 a	210	5.8±1.8 b
No. 10 Can	102	6.6±0.7 a	6.5±0.6 a	6.0±0.9 a	5.8±0.9 b	6.0±0.8 a	210	6.2±1.7 a

Appendix G. Quality Evaluation and Consumer Acceptance, Two-Factor Analysis of Variance for Nine Heat Processed Entrees Stored up to 36 Months at 21°C (Scales 1 to 9)
(Cont'd)

Technologists' Quality Scale Rating ¹							Consumer Panelists Acceptability ¹	
Food Name/ Variable (b)	No. of Judge- ments	Appear- ance	Odor	Flavor	Texture	Overall Quality	No. of Judge- ments	Hedonic Scale Rating
Beef Stew								
Storage Time, Months								
0	40	6.7±0.8 a	6.6±0.6 a	6.3±0.8 a	6.4±0.8 a	6.3±0.8 a	70	6.1±2.0 a
6	38	6.8±0.7 a	6.4±0.6 ab	6.3±0.9 a	6.4±0.7 ab	6.2±0.8 a	70	5.9±1.8 a
12	32	6.5±1.0 a	6.1±0.8 bc	5.7±1.1 ab	6.2±0.8 abc	5.8±1.0 ab	70	6.0±1.7 a
18	38	6.5±0.9 a	6.0±0.8 bc	5.8±1.0 ab	6.0±0.9 abc	5.8±0.9 ab	70	6.1±1.7 a
24	24	6.7±0.7 a	5.8±0.8 c	5.6±0.9 b	5.9±0.7 bc	5.7±0.8 ab	70	6.6±1.6 a
36	24	6.6±0.7 a	6.0±0.9 bc	5.3±1.0 b	5.8±1.0 c	5.3±1.0 b	70	6.2±1.7 a
Container, Tray Pack								
	98	6.7±0.7 a	6.3±0.8 a	6.1±0.9 a	6.1±0.9 a	6.1±0.9 a	210	6.2±1.8 a
No. 10 Can								
	98	6.5±0.9 a	6.1±0.8 a	5.7±1.1 b	6.2±0.8 a	5.8±1.0 b	210	6.1±1.7 a
Chicken Cacciatore								
Storage Time, Months								
0	40	6.4±0.7 a	6.2±0.7 a	5.9±0.8 a	5.9±0.9 a	5.9±0.8 a	70	5.9±1.9 a
6	34	5.8±0.7 ab	5.6±0.9 ab	5.2±0.8 b	5.3±1.1 ab	5.3±0.9 ab	70	5.6±1.7 a
12	34	5.9±1.0 ab	5.7±1.3 ab	5.4±1.1 b	5.5±1.2 ab	5.4±1.2 ab	70	5.5±2.0 a
18	34	5.9±1.1 ab	5.4±1.4 b	4.9±1.3 bc	5.4±1.2 ab	5.0±1.3 bc	70	5.6±2.0 a
24	26	5.5±1.3 b	5.2±1.4 b	5.0±1.3 bc	5.0±1.3 bc	5.0±1.4 bc	70	6.2±1.6 a
36	22	5.5±1.0 b	5.1±1.1 b	4.5±1.1 c	4.5±1.0 c	4.5±1.0 c	70	5.4±2.1 a
Container, Tray Pack								
	95	6.1±0.8 a	5.8±1.0 a	5.5±1.0 a	5.4±1.1 a	5.6±0.9 a	210	5.6±2.0 a
No. 10 Can								
	95	5.7±1.1 b	5.4±1.3 b	4.9±1.2 a	5.3±1.2 a	5.0±1.2 b	210	5.8±1.8 a

Appendix G. Quality Evaluation and Consumer Acceptance, Two-Factor Analysis of Variance for Nine Heat Processed Entrees Stored up to 36 Months at 21°C (Scales 1 to 9)
(Cont'd)

Technologists' Quality Scale Rating ¹							Consumer Panelists Acceptability ¹	
Food Name/ Variable (b)	No. of Judge- ments	Appear- ance	Odor	Flavor	Texture	Overall Quality	No. of Judge- ments	Hedonic Scale Rating
<u>Chili Con Carne</u>								
Storage Time, Months								
0	40	6.2 \pm 0.9 a	6.5 \pm 0.8 a	6.0 \pm 1.2 a	6.5 \pm 0.8 a	5.9 \pm 1.1 a	70	5.4 \pm 2.2 b
6	36	6.3 \pm 0.8 a	6.4 \pm 0.7 a	5.9 \pm 1.1 a	6.4 \pm 0.6 a	6.0 \pm 1.0 a	70	5.8 \pm 1.9 ab
12	34	6.1 \pm 1.0 a	6.4 \pm 0.7 a	5.9 \pm 1.3 a	6.5 \pm 0.7 a	5.9 \pm 1.1 a	70	5.2 \pm 2.3 b
18	28	6.1 \pm 0.9 a	6.1 \pm 0.8 a	5.8 \pm 1.0 a	6.0 \pm 0.9 a	5.9 \pm 0.9 a	70	6.3 \pm 1.7 a
24	30	6.1 \pm 0.7 a	6.0 \pm 0.7 a	5.4 \pm 1.3 a	6.1 \pm 0.7 a	5.5 \pm 1.3 a	70	6.3 \pm 1.8 a
36	22	6.4 \pm 0.7 a	6.1 \pm 0.8 a	5.7 \pm 0.9 a	6.1 \pm 0.6 a	5.8 \pm 0.8 a	70	6.1 \pm 1.6 a
Container, Tray Pack	95	6.2 \pm 0.8 a	6.4 \pm 0.6 a	6.0 \pm 1.0 a	6.3 \pm 0.8 a	6.0 \pm 1.0 a	210	6.1 \pm 2.1 a
No. 10 Can	95	6.2 \pm 0.9 a	6.1 \pm 0.9 b	5.6 \pm 1.2 b	6.3 \pm 0.7 a	5.7 \pm 1.1 b	210	5.6 \pm 1.8 b
<u>Creamed Chicken</u>								
Storage Time, Months								
0	40	6.0 \pm 0.9 a	5.9 \pm 1.1 a	5.8 \pm 1.2 a	5.9 \pm 1.0 a	5.8 \pm 1.0 a	70	5.5 \pm 2.0 a
6	36	5.9 \pm 1.0 a	5.9 \pm 1.1 a	5.7 \pm 1.1 a	6.2 \pm 0.6 a	5.7 \pm 0.9 a	70	6.1 \pm 2.0 a
12	28	5.8 \pm 1.1 a	5.8 \pm 1.0 a	5.7 \pm 1.3 a	6.2 \pm 0.8 a	5.8 \pm 1.1 a	70	6.2 \pm 1.6 a
18	32	5.9 \pm 0.9 a	5.7 \pm 0.9 a	5.6 \pm 1.1 a	5.9 \pm 0.9 ab	5.5 \pm 0.9 a	70	6.0 \pm 1.6 a
24	32	5.9 \pm 0.8 a	5.8 \pm 0.7 a	5.5 \pm 1.0 a	5.5 \pm 1.0 b	5.5 \pm 0.9 a	70	6.6 \pm 1.7 b
36	22	6.0 \pm 0.9 a	5.6 \pm 0.8 a	5.3 \pm 1.0 a	5.4 \pm 0.7 b	5.3 \pm 0.9 a	70	6.4 \pm 1.9 b
Container, Tray Pack	95	6.2 \pm 0.9 a	6.2 \pm 0.7 a	6.0 \pm 0.9 a	6.0 \pm 0.9 a	5.9 \pm 0.8 a	210	6.1 \pm 1.9 a
No. 10 Can	95	5.6 \pm 0.9 b	5.4 \pm 1.0 b	5.3 \pm 1.2 b	5.8 \pm 0.9 b	5.3 \pm 1.0 a	210	6.2 \pm 1.7 a

Appendix G. Quality Evaluation and Consumer Acceptance, Two-Factor Analysis of Variance for Nine Heat Processed Entrees Stored up to 36 Months at 21°C (Scales 1 to 9)
(Cont'd)

Technologists' Quality Scale Rating ¹							Consumer Panelists Acceptability ¹	
Food Name/ Variable (b)	No. of Judge- ments	Appear- ance	Odor	Flavor	Texture	Overall Quality	No. of Judge- ments	Hedonic Scale Rating
<u>Macaroni and Cheese</u>								
Storage Time, Months								
0	40	5.5+ <u>1.0</u> a	5.7+ <u>1.2</u> a	5.3+ <u>1.0</u> a	5.9+ <u>0.8</u> a	5.2+ <u>1.1</u> a	70	5.2+ <u>2.0</u> a
6	32	5.8+ <u>0.8</u> a	5.7+ <u>1.0</u> a	5.2+ <u>1.2</u> a	6.0+ <u>0.7</u> a	5.4+ <u>1.2</u> a	70	5.1+ <u>2.1</u> a
12	34	5.8+ <u>1.1</u> a	5.5+ <u>1.1</u> a	5.2+ <u>1.4</u> a	6.0+ <u>1.0</u> a	5.2+ <u>1.3</u> a	70	5.0+ <u>2.1</u> a
18	30	5.6+ <u>1.1</u> a	5.6+ <u>1.1</u> a	5.0+ <u>1.3</u> a	5.9+ <u>0.9</u> a	5.0+ <u>1.2</u> a	70	5.4+ <u>2.0</u> a
24	32	5.5+ <u>1.1</u> a	5.5+ <u>0.8</u> a	4.8+ <u>1.3</u> a	5.7+ <u>0.6</u> a	5.0+ <u>1.2</u> a	70	5.3+ <u>2.1</u> a
36	-	----- No Test Conducted -----					70	5.0+ <u>2.1</u> a
Container, Tray Pack	84	5.6+ <u>1.0</u> a	5.4+ <u>1.0</u> b	4.7+ <u>1.2</u> b	5.9+ <u>0.9</u> a	4.8+ <u>1.2</u> b	210	4.9+ <u>2.1</u> b
No. 10 Can	84	5.7+ <u>1.0</u> a	5.8+ <u>1.0</u> a	5.5+ <u>1.0</u> a	6.0+ <u>0.7</u> a	5.5+ <u>1.0</u> a	210	5.4+ <u>2.0</u> a
<u>Smoky Pork</u>								
Storage Time, Months								
0	38	6.4+ <u>0.7</u> a	6.6+ <u>0.6</u> a	6.3+ <u>1.0</u> a	6.5+ <u>0.8</u> a	6.3+ <u>0.9</u> a	70	6.2+ <u>1.6</u> a
6	34	5.8+ <u>0.9</u> b	6.2+ <u>0.8</u> a	5.9+ <u>1.1</u> a	6.0+ <u>1.0</u> ab	5.7+ <u>1.1</u> ab	70	6.5+ <u>1.6</u> a
12	28	5.7+ <u>1.1</u> b	5.9+ <u>1.0</u> b	5.7+ <u>1.1</u> ab	5.8+ <u>1.2</u> ab	5.7+ <u>1.1</u> ab	70	6.2+ <u>1.6</u> a
18	24	6.2+ <u>0.9</u> ab	6.0+ <u>1.3</u> ab	5.7+ <u>1.2</u> ab	5.8+ <u>1.2</u> ab	5.8+ <u>1.1</u> ab	70	5.9+ <u>1.8</u> a
24	20	5.8+ <u>0.9</u> b	5.5+ <u>1.2</u> b	5.1+ <u>1.3</u> b	5.4+ <u>1.2</u> b	5.2+ <u>1.3</u> b	70	6.2+ <u>1.7</u> a
36	24	5.9+ <u>1.0</u> b	6.0+ <u>1.0</u> b	5.5+ <u>1.2</u> ab	5.6+ <u>1.2</u> b	5.4+ <u>1.3</u> b	70	6.1+ <u>1.7</u> a
Container, Tray Pack	84	6.3+ <u>0.8</u> a	6.4+ <u>0.8</u> a	6.2+ <u>1.1</u> a	6.2+ <u>1.1</u> a	6.1+ <u>1.0</u> a	210	6.4+ <u>1.5</u> a
No. 10 Can	84	5.7+ <u>1.0</u> b	5.8+ <u>1.1</u> b	5.5+ <u>1.2</u> b	5.7+ <u>1.1</u> b	5.4+ <u>1.2</u> b	210	5.9+ <u>1.8</u> b

Appendix G. Quality Evaluation and Consumer Acceptance, Two-Factor Analysis of Variance for Nine Heat Processed Entrees Stored up to 36 Months at 21°C (Scales 1 to 9)
(Cont'd)

Technologists' Quality Scale Rating ¹							Consumer Panelists Acceptability ¹	
Food Name/ Variable (b)	No. of Judge- ments	Appear- ance	Odor	Flavor	Texture	Overall Quality	No. of Judge- ments	Hedonic Scale Rating
Swiss Steak								
Storage Time, Months								
0	34	6.5 \pm 0.8 a	6.7 \pm 0.6 a	6.1 \pm 1.1 a	6.1 \pm 1.2 a	6.1 \pm 1.1 a	70	5.6 \pm 2.3 a
6	32	6.7 \pm 0.6 a	6.2 \pm 0.8 a	6.0 \pm 1.0 ab	5.0 \pm 0.8 ab	5.9 \pm 0.8 ab	70	6.4 \pm 1.6 a
12	28	6.5 \pm 0.7 a	6.4 \pm 0.8 a	6.1 \pm 1.1 a	6.2 \pm 0.8 a	5.9 \pm 0.9 ab	70	6.0 \pm 1.9 a
18	28	6.7 \pm 0.6 a	6.3 \pm 0.9 a	5.8 \pm 1.1 ab	6.0 \pm 0.7 a	5.7 \pm 0.8 ab	70	6.2 \pm 1.6 a
24	18	6.6 \pm 0.5 a	6.4 \pm 0.6 a	5.4 \pm 0.9 ab	5.6 \pm 0.9 ab	5.6 \pm 0.9 ab	70	6.2 \pm 2.0 a
36	24	6.5 \pm 0.7 a	6.3 \pm 0.8 a	5.3 \pm 1.0 b	5.3 \pm 0.9 b	5.4 \pm 0.9 b	70	5.8 \pm 2.0 a
Container, Tray Pack	82	6.7 \pm 0.7 a	6.5 \pm 0.7 a	6.1 \pm 1.0 a	5.9 \pm 0.9 a	6.1 \pm 0.9 a	210	6.3 \pm 2.0 a
No. 10 Can	82	6.5 \pm 0.7 a	6.3 \pm 0.8 a	5.5 \pm 1.1 b	5.9 \pm 0.9 a	5.5 \pm 0.9 b	210	5.8 \pm 2.0 b

Footnote:

1 For each column (attribute), and for each main effect (storage time, container), mean values followed by different letters are significantly different at $P \leq 0.05$. The mean values for each main effect are averaged across the other main effect.

Appendix H. Quality Evaluation and Consumer Acceptance, Three-Factor Analysis of Variance for Nine Heat Processed Entrees Stored up to 18 Months (Scales 1 to 9)

Technologists' Quality Scale Rating ¹							Consumer Panelists Acceptability ¹	
Food Name/ Variable (b)	No. of Judge- ments	Appear- ance	Odor	Flavor	Texture	Overall Quality	No. of Judge- ments	Hedonic Scale Rating
Beef Burgundy with Rotini (NRDEC)								
Storage Time, Months								
0	80	6.3 \pm 0.8 a	6.3 \pm 0.9 a	6.3 \pm 1.0 a	6.2 \pm 0.9 a	6.2 \pm 1.0 a	140	6.4 \pm 1.9 a
6	68	6.4 \pm 0.8 a	6.2 \pm 1.0 a	6.0 \pm 1.0 ab	6.1 \pm 0.8 a	6.0 \pm 0.9 ab	140	6.6 \pm 1.9 a
12	64	6.4 \pm 0.7 a	6.0 \pm 1.1 ab	5.8 \pm 1.3 bc	5.9 \pm 1.0 a	5.7 \pm 1.2 bc	140	6.4 \pm 1.8 a
18	64	6.3 \pm 0.7 a	5.8 \pm 0.9 b	5.5 \pm 1.2 c	5.5 \pm 1.0 b	5.4 \pm 1.1 c	140	6.5 \pm 1.4 a
Container, Tray Pack	138	6.5 \pm 0.8 a	6.2 \pm 0.9 a	6.1 \pm 1.1 a	6.0 \pm 1.0 a	6.0 \pm 1.0 a	280	6.6 \pm 1.8 a
No. 10 Can	138	6.2 \pm 0.7 b	6.0 \pm 1.1 a	5.8 \pm 1.2 b	5.9 \pm 1.0 a	5.7 \pm 1.1 b	280	6.4 \pm 1.7 a
Storage Temperature								
21°C	138	6.4 \pm 0.7 a	6.2 \pm 0.9 a	6.1 \pm 1.1 a	6.0 \pm 1.0 a	6.0 \pm 1.0 a	280	6.8 \pm 1.6 a
38°C	138	6.3 \pm 0.8 a	6.0 \pm 1.1 b	5.8 \pm 1.2 b	5.8 \pm 1.0 a	5.7 \pm 1.1 a	280	6.3 \pm 1.9 b
Beef Ravioli (Kraft)								
Storage Time, Months								
0	79	6.5 \pm 0.9 a	6.6 \pm 0.7 a	6.1 \pm 1.1 a	6.2 \pm 1.1 a	6.1 \pm 1.0 a	140	5.9 \pm 1.7 a
6	68	6.6 \pm 0.6 a	6.6 \pm 0.6 a	6.0 \pm 0.9 a	6.1 \pm 0.8 a	6.1 \pm 0.9 a	140	5.9 \pm 1.8 a
12	72	6.7 \pm 0.6 a	6.4 \pm 0.7 a	5.8 \pm 1.2 a	6.1 \pm 1.0 a	5.9 \pm 1.2 a	140	5.3 \pm 2.0 b
18	76	6.6 \pm 0.7 a	6.6 \pm 0.6 a	6.0 \pm 0.9 a	6.0 \pm 0.8 a	6.0 \pm 0.8 a	140	5.5 \pm 2.1 ab
Container, Tray Pack	148	6.6 \pm 0.8 a	6.6 \pm 0.7 a	6.1 \pm 1.1 a	6.4 \pm 0.8 a	6.2 \pm 1.0 a	280	5.8 \pm 1.9 a
No. 10 Can	147	6.6 \pm 0.7 a	6.5 \pm 0.6 a	5.9 \pm 1.0 b	5.8 \pm 0.9 b	5.9 \pm 0.9 b	280	5.5 \pm 2.0 a
Storage Temperature								
21°C	147	6.7 \pm 0.6 a	6.6 \pm 0.6 a	6.1 \pm 1.0 a	6.1 \pm 1.0 a	6.1 \pm 0.9 a	280	5.8 \pm 1.9 a
38°C	148	6.5 \pm 0.8 a	6.5 \pm 0.7 a	5.8 \pm 1.0 b	6.1 \pm 0.9 a	6.0 \pm 1.0 a	280	5.5 \pm 1.9 a

Appendix H. Quality Evaluation and Consumer Acceptance, Three-Factor Analysis of Variance for Nine Heat Processed Entrees Stored up to 18 Months (Scales 1 to 9) (Cont'd)

Technologists' Quality Scale Rating ¹							Consumer Panelists Acceptability ¹	
Food Name/ Variable (b)	No. of Judge- ments	Appear- ance	Odor	Flavor	Texture	Overall Quality	No. of Judge- ments	Hedonic Scale Rating
Beef Stew								
(Kraft)								
Storage Time, Months								
0	80	6.7 \pm 0.8 a	6.5 \pm 0.6 a	6.3 \pm 0.8 a	6.4 \pm 0.9 a	6.2 \pm 0.9 a	140	6.1 \pm 2.1 a
6	76	6.7 \pm 0.8 a	6.3 \pm 0.8 a	6.0 \pm 1.0 a	6.3 \pm 0.8 a	5.9 \pm 0.9 a	140	5.6 \pm 1.9 a
12	64	6.5 \pm 0.8 a	5.9 \pm 0.9 b	5.5 \pm 1.0 b	6.1 \pm 1.0 ab	5.6 \pm 1.0 b	140	5.9 \pm 1.7 a
18	76	6.4 \pm 1.0 a	5.8 \pm 0.9 b	5.4 \pm 1.0 b	5.9 \pm 0.9 b	5.5 \pm 1.0 b	140	5.6 \pm 1.8 a
Container, Tray Pack	148	6.8 \pm 0.7 a	6.2 \pm 0.8 a	6.1 \pm 0.9 a	6.1 \pm 0.9 a	6.0 \pm 0.9 a	280	6.0 \pm 1.8 a
No. 10 Can	148	6.4 \pm 1.0 b	6.1 \pm 0.9 b	5.5 \pm 1.0 b	6.2 \pm 0.9 a	5.6 \pm 1.0 b	280	5.6 \pm 2.0 b
Storage Temperature								
21°C	148	6.6 \pm 0.8 a	6.3 \pm 0.8 a	6.0 \pm 1.1 a	6.3 \pm 0.8 a	6.0 \pm 0.9 a	280	5.8 \pm 1.8 a
38°C	148	6.6 \pm 0.9 b	6.0 \pm 0.9 b	5.6 \pm 1.0 b	6.1 \pm 0.9 a	5.6 \pm 1.1 b	280	5.8 \pm 2.0 a
Chicken								
Cacciatore								
(NRDEC)								
Storage Time, Months								
0	80	6.3 \pm 0.7 a	6.2 \pm 0.7 a	5.8 \pm 1.0 a	5.9 \pm 0.9 a	5.8 \pm 0.9 a	140	5.9 \pm 1.8 a
6	68	5.7 \pm 0.9 b	5.6 \pm 1.0 b	5.1 \pm 1.0 b	5.3 \pm 1.1 b	5.2 \pm 1.0 b	140	5.3 \pm 1.8 b
12	68	5.9 \pm 1.0 b	5.5 \pm 1.2 b	5.1 \pm 1.2 b	5.3 \pm 1.2 b	5.2 \pm 1.2 b	140	5.2 \pm 1.8 b
18	68	5.5 \pm 1.3 b	5.2 \pm 1.5 b	4.6 \pm 1.4 c	5.0 \pm 1.3 b	4.7 \pm 1.4 c	140	5.1 \pm 2.1 b
Container, Tray Pack	142	6.1 \pm 0.9 a	5.8 \pm 1.0 a	5.5 \pm 1.0 a	5.5 \pm 1.1 a	5.6 \pm 1.0 a	280	5.7 \pm 1.9 a
No. 10 Can	142	5.7 \pm 1.1 b	5.4 \pm 1.3 b	4.9 \pm 1.3 b	5.3 \pm 1.3 a	5.0 \pm 1.3 b	280	5.1 \pm 1.9 b
Storage Temperature								
21°C	142	6.0 \pm 0.9 a	5.7 \pm 1.1 a	5.4 \pm 1.1 a	5.5 \pm 1.1 a	5.4 \pm 1.1 a	280	5.5 \pm 1.7 a
38°C	142	5.8 \pm 1.1 a	5.5 \pm 1.3 a	5.0 \pm 1.3 b	5.3 \pm 1.3 a	5.1 \pm 1.3 b	280	5.2 \pm 2.1 b

Appendix H. Quality Evaluation and Consumer Acceptance, Three-Factor Analysis of Variance for Nine Heat Processed Entrees Stored up to 18 Months (Scales 1 to 9) (Cont'd)

Technologists' Quality Scale Rating ¹							Consumer Panelists Acceptability ¹	
Food Name/ Variable (b)	No. of Judge- ments	Appear- ance	Odor	Flavor	Texture	Overall Quality	No. of Judge- ments	Hedonic Scale Rating
<u>Chili con</u>								
<u>Carne (Kraft)</u>								
Storage Time, Months								
0	80	6.1 \pm 1.0 a	6.5 \pm 0.8 a	6.0 \pm 1.2 a	6.5 \pm 0.7 a	5.9 \pm 1.0 a	140	5.5 \pm 2.2 bc
6	71	6.3 \pm 0.8 a	6.4 \pm 0.7 a	5.9 \pm 1.0 a	6.4 \pm 0.6 a	6.0 \pm 0.9 a	140	5.8 \pm 1.9 ab
12	68	6.1 \pm 0.9 a	6.3 \pm 0.8 a	5.6 \pm 1.2 ab	6.3 \pm 0.8 a	5.6 \pm 1.0 a	140	5.0 \pm 2.2 c
18	56	6.0 \pm 0.9 a	5.9 \pm 1.0 b	5.4 \pm 1.3 b	6.0 \pm 0.8 b	5.5 \pm 1.2 a	140	6.0 \pm 1.8 a
Container, Tray Pack								
	137	6.2 \pm 0.8 a	6.4 \pm 0.8 a	5.9 \pm 1.1 a	6.3 \pm 0.8 a	5.9 \pm 1.1 a	280	5.7 \pm 2.1 a
No. 10 Can								
	138	6.1 \pm 0.9 a	6.2 \pm 0.9 a	5.6 \pm 1.2 b	6.4 \pm 0.7 a	5.7 \pm 1.0 a	280	5.4 \pm 2.1 a
Storage Temperature								
21°C								
	138	6.2 \pm 0.9 a	6.4 \pm 0.8 a	5.9 \pm 1.2 a	6.4 \pm 0.8 a	5.9 \pm 1.0 a	280	5.8 \pm 1.9 a
38°C								
	137	6.1 \pm 0.9 a	6.2 \pm 0.9 a	5.6 \pm 1.2 b	6.3 \pm 0.8 a	5.6 \pm 1.2 b	280	5.2 \pm 2.2 b
<u>Creamed</u>								
<u>Chicken</u>								
<u>(Kraft)</u>								
Storage Time, Months								
0	80	6.0 \pm 0.8 a	6.0 \pm 1.1 a	5.9 \pm 1.2 a	6.0 \pm 1.0 a	5.8 \pm 1.0 a	140	5.5 \pm 2.0 a
6	72	5.6 \pm 1.2 a	5.6 \pm 1.2 b	5.5 \pm 1.2 b	5.8 \pm 1.0 ab	5.3 \pm 1.2 b	140	5.7 \pm 2.0 a
12	56	5.3 \pm 1.2 b	5.5 \pm 1.0 b	5.1 \pm 1.4 bc	5.7 \pm 1.1 ab	5.1 \pm 1.3 bc	140	5.7 \pm 1.9 a
18	64	5.2 \pm 1.2 b	5.2 \pm 1.4 b	5.0 \pm 1.3 c	5.5 \pm 1.0 b	4.9 \pm 1.1 c	140	5.4 \pm 1.8 a
Container, Tray Pack								
	136	5.9 \pm 1.1 a	6.0 \pm 1.0 a	5.8 \pm 1.2 a	6.0 \pm 0.9 a	5.7 \pm 1.2 a	280	6.0 \pm 1.8 a
No. 10 Can								
	136	5.2 \pm 1.1 b	5.2 \pm 1.2 b	5.0 \pm 1.3 b	5.5 \pm 1.1 b	5.0 \pm 1.1 b	280	5.2 \pm 1.9 b
Storage Temperature								
21°C								
	136	5.9 \pm 1.0 a	5.8 \pm 1.0 a	5.7 \pm 1.2 a	6.1 \pm 0.8 a	5.7 \pm 1.0 a	280	5.7 \pm 1.8 a
38°C								
	136	5.2 \pm 1.2 b	5.3 \pm 1.2 b	5.1 \pm 1.4 b	5.4 \pm 1.1 b	4.9 \pm 1.3 b	280	5.5 \pm 2.0 a

Appendix H. Quality Evaluation and Consumer Acceptance, Three-Factor Analysis of Variance for Nine Heat Processed Entrees Stored up to 18 Months (Scales 1 to 9) (Cont'd)

Technologists' Quality Scale Rating ¹							Consumer Panelists Acceptability ¹	
Food Name/ Variable (b)	No. of Judge- ments	Appear- ance	Odor	Flavor	Texture	Overall Quality	No. of Judge- ments	Hedonic Scale Rating
<u>Macaroni and Cheese (Kraft)</u>								
Storage Time, Months								
0	79	5.4 \pm 1.1 a	5.7 \pm 1.1 a	5.3 \pm 1.0 a	5.9 \pm 0.8 a	5.3 \pm 1.0 a	140	5.2 \pm 2.0 a
6	64	5.6 \pm 1.0 a	5.6 \pm 0.9 a	5.0 \pm 1.3 a	5.8 \pm 0.8 a	5.1 \pm 1.3 a	140	5.1 \pm 2.1 a
12	68	5.3 \pm 1.3 a	5.3 \pm 1.2 ab	4.9 \pm 1.3 a	6.0 \pm 0.9 a	4.9 \pm 1.3 a	140	4.7 \pm 2.1 a
18	60	4.7 \pm 1.4 b	5.1 \pm 1.3 b	4.3 \pm 1.3 b	5.7 \pm 1.0 a	4.2 \pm 1.3 b	140	5.0 \pm 2.0 a
Container, Tray Pack	135	5.3 \pm 1.1 a	5.3 \pm 1.1 b	4.6 \pm 1.2 b	5.9 \pm 0.9 a	4.7 \pm 1.2 b	280	4.7 \pm 2.0 ab
No. 10 Can	136	5.2 \pm 1.4 a	5.6 \pm 1.2 a	5.2 \pm 1.2 a	5.9 \pm 0.8 a	5.2 \pm 1.3 a	280	5.2 \pm 2.1 a
<u>Storage Temperature</u>								
21°C	136	5.7 \pm 1.0 a	5.6 \pm 1.1 a	5.2 \pm 1.2 a	5.9 \pm 0.8 a	5.2 \pm 1.2 a	280	5.2 \pm 2.1 a
38°C	135	4.9 \pm 1.3 b	5.3 \pm 1.2 b	4.6 \pm 1.3 b	5.8 \pm 0.9 a	4.6 \pm 1.3 b	280	4.8 \pm 2.0 b
<u>Smoky Pork (NRDEC)</u>								
Storage Time, Months								
0	76	6.5 \pm 0.7 a	6.6 \pm 0.5 a	6.4 \pm 0.8 a	6.5 \pm 0.8 a	6.4 \pm 0.8 a	140	6.2 \pm 1.6 a
6	68	5.9 \pm 0.9 b	6.1 \pm 0.9 b	5.8 \pm 1.1 b	5.9 \pm 1.0 b	5.7 \pm 1.0 b	140	6.2 \pm 1.7 a
12	56	5.9 \pm 1.0 b	5.9 \pm 1.0 b	5.5 \pm 1.2 b	5.6 \pm 1.3 b	5.5 \pm 1.2 b	140	5.7 \pm 1.9 a
18	48	5.9 \pm 1.0 b	5.9 \pm 1.2 b	5.4 \pm 1.2 b	5.6 \pm 1.2 b	5.5 \pm 1.2 b	140	5.4 \pm 1.9 b
Container, Tray Pack	124	6.3 \pm 0.8 a	6.5 \pm 0.8 a	6.2 \pm 0.9 a	6.2 \pm 1.0 a	6.2 \pm 0.8 a	280	6.2 \pm 1.7 a
No. 10 Can	124	5.9 \pm 1.0 b	5.9 \pm 1.0 b	5.5 \pm 1.2 b	5.7 \pm 1.2 b	5.5 \pm 1.2 b	280	5.6 \pm 1.9 b
<u>Storage Temperature</u>								
21°C	124	6.0 \pm 0.9 a	6.2 \pm 0.9 a	6.0 \pm 1.1 a	6.1 \pm 1.1 a	5.9 \pm 1.0 a	280	6.2 \pm 1.6 a
38°C	124	6.1 \pm 0.9 a	6.1 \pm 1.0 a	5.7 \pm 1.2 a	5.9 \pm 1.1 a	5.8 \pm 1.1 a	280	5.6 \pm 1.9 b

Appendix H. Quality Evaluation and Consumer Acceptance, Three-Factor Analysis of Variance for Nine Heat Processed Entrees Stored up to 18 Months (Scales 1 to 9) (Cont'd)

Technologists' Quality Scale Rating ¹							Consumer Panelists Acceptability ¹	
Food Name/ Variable (b)	No. of Judge- ments	Appear- ance	Odor	Flavor	Texture	Overall Quality	No. of Judge- ments	Hedonic Scale Rating
Swiss Steak								
(NRDEC)								
Storage Time, Months								
0	68	6.5±0.8 a	6.7±0.6 a	6.0±1.0 a	6.1±1.1 a	6.1±1.1 a	140	5.6±2.2 b
6	64	6.6±0.6 a	6.2±0.8 b	6.0±1.0 a	5.7±1.0 a	5.8±0.9 ab	140	6.3±1.7 a
12	56	6.4±0.8 a	6.3±0.7 b	5.9±1.1 a	6.1±0.8 a	5.7±1.0 ab	140	5.9±1.9 ab
18	56	6.6±0.6 a	6.2±0.9 b	5.6±1.1 a	5.8±0.9 a	5.6±0.8 b	140	5.8±1.8 ab
Container, Tray Pack	122	6.7±0.6 a	6.5±0.7 a	6.2±1.0 a	6.0±1.0 a	6.1±0.9 a	280	6.1±1.9 a
No. 10 Can	122	6.4±0.8 b	6.3±0.8 b	5.5±1.0 b	5.9±1.0 a	5.6±0.9 b	280	5.7±2.0 b
Storage Temperature								
21°C	122	6.6±0.7 a	6.4±0.8 a	6.0±1.1 a	6.0±0.9 a	5.9±0.9 a	280	6.2±1.9 a
38°C	122	6.5±0.8 a	6.3±0.7 a	5.7±1.1 a	5.9±1.1 a	5.7±1.0 a	280	5.6±2.0 b

¹ For each column (attribute), mean values followed by different letters are significantly different at $P \leq 0.05$. Mean values for each main effect (storage time, container, temperature) are averaged across the other two main effects.

Appendix I. Results of Container Examinations, Nine Entrees, After Storage

NRDEC Products	Withdrawal	Container	Observations, Two Containers
Beef Burgundy	6 Months	No. 10 Cans	21°C: Lids stained, some enamel fingernail soft 38°C: Lids stained, some enamel fingernail soft
		Tray Packs	- : Slight gray splotches, body enamel; slight browning on covers
	12 Months	Aluminum Pans	-18°C: No deterioration/pitting
		No. 10 Cans	21°C: Slight stain to fingernail soft lid enamel, 10 & 50% of surfaces 38°C: Pronounced staining and fingernail soft lid enamel, 10 & 15% of surfaces
	36 Months	No. 10 Cans	21°C: Slight staining and enamel softening of enamel on can ends and body, easily scratched with fingernail
		Tray Packs	21°C: Slight staining of can body and lid. Enamel could not be scratched with fingernail
Chicken Cacciatore	12 Months	No. 10 Cans	- : Lids stained, enamel slightly fingernail soft. Can body enamel near lid seam stained and fingernail soft
		Tray Packs	38°C: Slight brownish blotches on one lid; reddish hue to enamel of other body
	18 Months	Aluminum Pans	-18°C: No deterioration/pitting
		No. 10 Cans	21°C: Few scratches on body enamel; lids stained and fingernail soft, 30 & 60% of surfaces 38°C: Ditto for scratches on body enamel; staining on lids, fingernail soft, 10 & 20% of surfaces
		Tray Packs	- : Slight buff cast on can bodies; very slight tan stains on lids
	36 Months	No. 10 Cans	21°C: Traces of corrosion on can bodies. On lids, enamel softening of stained areas, can be scratched with fingernail
		Tray Packs	21°C: Same degree of staining as at 18 Months

Appendix I. Results of Container Examinations, Nine Entrees, After Storage (Cont'd)

NRDEC Products	Withdrawal	Container	Observations, Two Containers
Smoky Pork	6 Months	No. 10 Cans	- : Severe staining, softening and peeling of lid enamel
		Tray Packs	- : Very slight brownish stain on lids; slight pinkish stains on bodies
	12 Months	Aluminum Pans	-18°C: No deterioration
		No. 10 Cans	21°C: Extensive enamel softening and separation on 20% of area on lids and lid end of body; 1/2" wide maximum stain developed on lid end of body 38°C: Extensive enamel softening and separation on 90% of area on lids and end of body; same development of staining on lid as for 21°C containers.
		Tray Packs	- : Faint brownish blotches on lids; faint pinkish blotches on body
	36 Months	No. 10 Cans	21°C: Extensive softening and peeling of lid enamel; slight corrosion on exposed base metal. Slight softening of body enamel.
		Tray Packs	21°C: Lid and body enamel in good condition; traces of staining
Swiss Steak	12 Months	No. 10 Cans	Both Temperatures: Lid enamel stained and fingernail soft, 5, 10, 30 & 60% of areas. Maximum of 3/8" of enamel at lid end of body stained and fingernail soft
		Tray Packs	- : Very slight brownish stain on 10 & 15% of lid area; a few very slight grey stains on bodies
	18 Months	Aluminum Pans	-18°C: Corrosion patterns on pan ends; penetration had occurred (1).
		No. 10 Cans	21°C: Enamel of lids stained and fingernail soft, 25 & 85% of area 38°C: Same as above; 20 & 65% of area
		Tray Packs	- : Slight staining of enamel

Appendix I. Results of Container Examinations, Nine Entrees, After Storage (Cont'd)

NRDEC Products	Withdrawal	Container	Observations, Two Containers
Swiss Steak (Cont'd)	36 Months	No. 10 Cans	21°C: Slight staining and softening of lid enamel
		Tray Packs	21°C: Very slight staining of lid and body; enamel in excellent condition, could not be scratched with fingernail
Kraft Products	Withdrawal	Container	Observations, Two Containers
Beef Ravioli	12 Months	No. 10 Cans	- : No enamel deterioration
		Tray Packs	- : Heating blisters on lids
	18 Months	Aluminum Pans	-18°C: Orange hue stains on food contact surfaces
		No. 10 Cans	- : Slight corrosion due to 1/16" pinholing and scratching of enamel. One of two 38° stored containers had slide 100 major defect. (2)
	36 Months	No. 10 Cans	- : Slight to moderate corrosion on inside enamel- ed, tinplated bodies. Trace of corrosion on inside enameled tin free steel ends.
		Tray Packs	- : Trace of corrosion on inside enamel tinplate steel bodies and lids
Beef Stew	12 Months	No. 10 Cans	- : No enamel deterioration
		Tray Packs	- : Heating blisters on lids
	18 Months	Aluminum Pans	-18°C: No deterioration
		No. 10 Cans	- : Virtually no deterioration of enamel, slight dulling only
		Tray Packs	- : Heating blisters on lids
	36 Months	No. 10 Cans	- : Enamel/container in good condition
Tray Packs		- : Heating blisters on lids	

Appendix I. Results of Container Examinations, Nine Entrees, After Storage (Cont'd)

Kraft Products	Withdrawal	Container	Observations, Two Containers
Chili con Carne	12 Months	No. 10 Cans	- : No deterioration of enamel on container
		Tray Packs	- : Heating blisters on lids
	18 Months	Aluminum Pans	-18°C: No deterioration
		No. 10 Cans	- : No deterioration
		Tray Packs	- : Heating blisters on lids
	36 Months	No. 10 Cans	: In good condition
		Tray Packs	: Heating blisters found on lid by rubbing with fingers
Creamed Chicken	12 Months	No. 3 Tall Cans	-21°C: Pigmented aluminum enameled body ends; amber enameled lids. Code stamp deeply embossed in lids resulting in enamel break-through. Tinplate bodies slightly corroded. Very slight exposure of base metal of 21°C can bodies; more exposure of base metal, 38°C bodies.
		Tray Packs	- : Heating blisters on lids
	18 Months	Aluminum Pans	-18°C: No deterioration
		No. 3 Tall Cans	21°C: No deterioration of body end or lid enamel. Tinplate bodies detinned; defect concentrated around lid seam and beaded areas. Some base metal exposed. 38°C: Signs of corrosion on code stamp. More can body detinning than 21°C cans - about 75% of tinplate still bright.
		Tray Packs	- : Heating blisters on lids

Appendix I. Results of Container Examinations, Nine Entrees, After Storage (Cont'd)

Kraft Products	Withdrawal	Container	Observations, Two Containers
Creamed Chicken (Cont'd)	36 Months	No. 3 Tall	21°C: Body end and lid enamel in good condition except for slight corrosion an lid code stamp. Moderate corrosion on tinplate bodies and slight to moderate base metal exposure.
		Tray Packs	21°C: Traces of heating blisters on lids found by rubbing with fingers
Macaroni and Cheese	12 Months	No. 10 Cans	- : No deterioration
		Tray Packs	- : Heating blisters on lids
	18 Months	Aluminum Pans	-18°C: No deterioration
		No. 10 Cans	- : No deterioration
		Tray Packs	- : Heating blisters on lids
	36 Months	No. 10 Cans	: In good condition
		Tray Packs	: Trace of heating blisters found on lid by rubbing with fingers

(1) At the conclusion of 18 months storage, the remaining foil pans containing NRDEC-produced precooked frozen products were examined for development of corrosion. Results were as follows:

Product	No. of Pans	No. Corroded	Percent
Beef Burgundy	13	3	23
Chicken Cacciatore	11	2	18
Smoky Pork	10	6	60
Swiss Steak	4	2	50
Totals:	38	13	34

(2) Slide 100 from: Visual Inspection Guide (Metal) Food Containers. Pictorial Key to Projection Slide Series PS-20. U.S.D.A., A.M.S., Fruit and Vegetable Division, Processed Products Standardization and Inspection Branch. File Code 125-A-21, January 1976. Slide description: enamel fracture with excessive etching confined mostly in inside container beads. MAJOR DEFECT.